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Public Works Department Metrics for Keflavik, Iceland

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Report

Presented to the Faculty of the Graduate School

of The University of Texas at Austin

in Partial Fulfillment

of the Requirements

for the Degree of

Master of Science in Engineering

The University of Texas at Austin

August 1997

DTIC QUALITY INSPECTED 4

19980323 090

Public Works Department Metrics for Keflavik, Iceland

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1. Introduction

The Total Quality Philosophy had its start in the Navy in 1985. Ten years later, this philosophy has stalled in the middle management area of the workplace. These managers know how to repair broken machinery or design facilities, but lack the management skills necessary to lead and encourage the workforce they manage into the next century.

A few years ago, Commander-in-Chief, US Atlantic Fleet, (CINCLANTFLT) created a metrics program (DON 1996) to better understand the operations of the various bases. (The Navy has had a similar program for operational ships for decades, but shore establishments were excluded due to the various complexities and diverse locations.) As the Navy developed this program, requests for data went out to the individual bases for input. The underlying problem in the whole process was that the "experts" in the metrics operations did not fully understand the type of business the various commands performed throughout the world. They even asked the base operators for "data that would make for a good metric." Since the process owners had no understanding of what made for a good metric, they were unable to fulfill the requirements to produce satisfactory results.

Public Works Iceland has collected data over the years concerning several issues, but middle management simply collected data and sent this information up the chain of command to the Public Works Officer. The workforce never saw the data, knew what the data said, or saw the outcome of the report. As an example, the workforce is required to submit their annual leave plan in an effort to ensure a sufficient workforce at any time. This information is used to schedule the work hours for the year. Data are collected to compare

the actual leave with the scheduled leave and compare this to the production cycle. This report is sent up the chain of command, but the workforce does not see this report or understand the relationship between scheduled and actual leave. Keeping the workers informed about overall productivity and the meaning of the measured data is the responsibility of the middle managers. Indeed, making sure that the right data are collected is also management's responsibility.

1.1 Scope

A successful manager's job is not as a drill sergeant barking orders to his platoon, but as a coach coordinating his players' actions to become more successful. A manager must provide for the needs of his people: direction, knowledge, resources, and support (Byham 1988).

- Direction is provided by establishing key result areas, goals and measurements.
- Knowledge involves needed job skills, technical training, data, information, expertise.
- Resources required for a successful team performance include tools, materials, facilities, time and money.
- Support is the foundation and catalyst for the team -- approval, encouragement, feedback, reinforcement, recognition

Much has been written concerning these four areas. The scope of this paper is to focus on the "direction" area by analyzing the metrics at the Public Works Department (PWD), Keflavik Iceland. Metrics provide the direction needed for growth by identifying key result areas, measurements, and goals. Key result areas address the direction an organization wishes to go. Measurement is a way of knowing if the organization is moving in the right direction in terms of the key result areas. Finally, the goals provide for a level of achievement or set a standard to reach for.

Before Key Result Areas can be established, an understanding of the organization's processes is vital. A useful tool in this analysis is the SIPOC diagram. SIPOC stands for Supplier - Input - Process - Output - Customer. Suppliers are the individuals or other organizations that provide an input or supplies for the processes. The customers are the individuals or organizations that use the output generated by the processes. Figure 1 shows an example of a simple SIPOC diagram for one area of PWD Keflavik. SIPOC's for the entire PWD Keflavik are given in Appendix A and discussed further in Chapter 3.

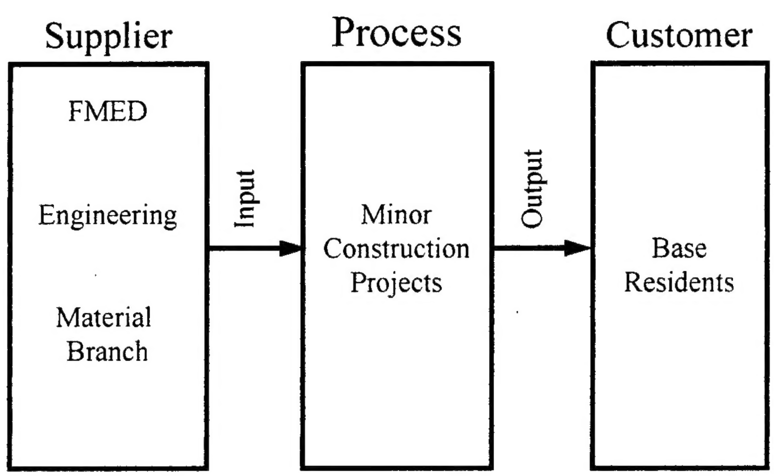


Figure 1 - SIPOC Diagram

1.2 Objectives

The objectives of this report are as follows:

1. Develop SIPOC diagrams for PWD Keflavik.
2. Capture the existing measures and reporting techniques at PWD Keflavik.
3. Analyze the measures for viability.
4. Develop a list of viable metrics (Remove the measures that are unnecessary and add any that are necessary for PWD Keflavik.)
5. Develop a training plan for the PWD Keflavik workers in the data gathering and reporting of the metrics.

2. Background

2.1 Mission of Public Works

Throughout the Navy, Public Works Departments are tasked with maintaining the shore facilities that support the world-wide fleet. Without such support, the ships and planes that project America's presence to the far reaches of the world would be impossible. PWDs vary in size from small units where the maintenance force is composed of civilian contracted labor to large departments made up of government civilian and military labor. Regardless of size, the basic mission of PWDs is to provide public works services to the bases and its operating commands. These services include facility maintenance, utilities, transportation service, engineering support, and environmental services.

2.1.1 Size

Public Works Department, Keflavik is composed of military forces along with both US and Icelandic civilian personnel. The department is composed of six military officers, 58 enlisted, five US civilians and 260 Icelandic civilians. Typical duty length for the military is 1.5 years (unaccompanied) to 2.5 years (accompanied). Due to the frequency of the rotating positions, the Icelanders provide a continuation to the overall direction of Public Works.

Public Works' basic functions are shown in figure 2 and can be broken into two categories: support and operational. The support comes in the form of engineering, planning, and administrative assistance. Contracting and environmental divisions provide both support and operational duties. The operational backbone of the PWD is the maintenance, utility, and transportation divisions. These divisions are composed of Icelandic civilians and augmented with the enlisted military personnel. They perform duties ranging from minor repairs and preventive maintenance, to major renovations of facilities. In addition, they operate and maintain the base power plant, water plant and all government vehicles on base.

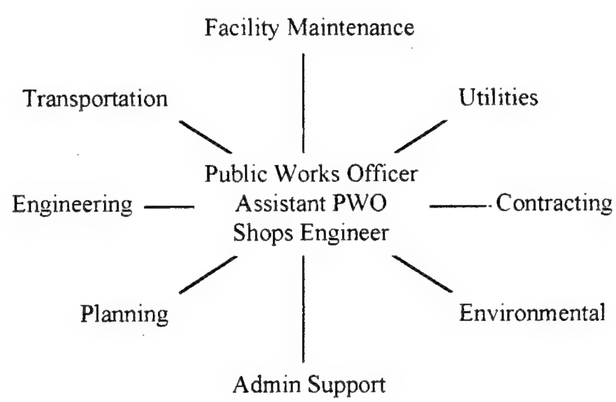


Figure 2 - Public Works Organization

2.1.2 Location

Iceland is located just south of the Arctic Circle in the Atlantic Ocean (figure 3). Naval Air Station Keflavik lies on the southwest corner of Iceland which makes for some unique problems. A harsh environment coupled with a unique terrain present a tremendous

Figure 3 - Location of Keflavik, Iceland

challenge to maintain a fully operational base. Low temperatures, high winds, combined with rain and snow, provide a new definition of a "challenging environment."

2.2 Why Measure?

"Why measure?" is perhaps the most common question asked by management when addressing the subject of metrics. The answer resides in the fact that items that are measured are items that see improvement over time. The realm of measuring comprises many facets and is possibly overwhelming for some. An understanding into the basics of measurements is the first stage of developing a successful program.

2.2.1 Types of measurements

Measurements can be broken into three classes: anecdotal, subjective, and objective. Anecdotal information is that which comes from one source or one person's opinion. Depending on the individual experience, the rating might be favorable or unfavorable. Subjective measurements also contain personal feelings but are from a larger source of information. These might be in the form of opinion polls, surveys, and questionnaires.

Objective measurements are the most accurate form of information since they are not affected by personal feelings or prejudices. These measurements are based on facts and, if done correctly, are unbiased. The difficulty most managers have in using measurements is their desire to use objective data, but subsequently reacting to anecdotal statements from their boss or customers.

2.2.2 Types of performance measures

Performance measures rely on the objective class of measurements. Since objective data are not based on personal feelings or prejudices, a realistic picture of the operation is possible. Research into measurements has developed some lengthy lists, but most performance measures can be broken into four types (Ammons 1995):

- Workload measures
- Efficiency measures
- Effectiveness measures
- Productivity measures

Workload measures indicate the amount of work performed or the amount of services received by the customer. Examples of workload measurements include number of service calls received, amount of estimates completed, amount of design work completed. While this type of measurement is useful to determine the amount of work done, it does not show efficiency or effectiveness.

Efficiency measures illustrate the relationship between the work performed and the resources required to perform it. Most efficiency measurements are presented as unit costs. Unit costs are calculated by dividing total costs of a service or function by the number of units provided. For example, if a 200 meter underground electrical line is installed for a cost

of $50,000. The unit cost is $250/meter. Similar costs can be calculated for engineering design, estimates, transportation repairs, and various other functions within a PWD. When these costs are compared to past performance or unit costs by contracting, wise decisions can be made when allocating resources.

Effectiveness measures reflect the degree to which performance objectives are being achieved or reflect the quality of the organization's performance. The number of work hours spent on construction re-work or error free engineering designs are examples of effectiveness measures.

Productivity measures combine the dimensions of efficiency and effectiveness into a single indicator. For example, "time spent on a maintenance service call" would measure efficiency and "percentage service calls completed properly" (i.e., not called back for the same problem) would reflect effectiveness. "Labor-hours per effective service call completion" would indicate productivity.

2.2.3 Attributes of good metrics

Developing a set of metrics is a fairly simple task. Developing a set of **useful** metrics is the difficult part. Too often managers try to improve their organization by creating new measures to report. The weakness in this approach comes from not fully understanding the qualities that make up a quality metric. The following list attempts to provide a framework or guideline for managers when deciding what and how to measure their processes (Tucker 1997). Successful metrics must:

- Be accepted as meaningful to the customer
- Tell how well an organization's processes and tasks fulfill its goals and objectives
- Be simple, understandable, logical and repeatable

- Be timely
- Show a trend
- Be clearly defined
- Be economical to collect the data
- Drive the appropriate action

2.2.4 Overcoming resistance to performance measurement

Even if all these criteria are met, people will still resist performance measurement. Performance measurement is seen as a threat by various groups in an organization. Middle management might feel threatened as the upper levels of management get a closer look into their "sacred" operations. Employees feel that measuring will lead to tougher work standards and less favorable working conditions and perhaps even layoffs. Even with the best programs and most accurate set of measurements, overcoming resistance by employees is still a factor to consider. David Ammons (1995) mentions several reasons people resist measurement:

- "You can't measure what I do"
- "You're measuring the wrong thing"
- "It costs too much and we don't have the resources"
- "I don't want to know how I am doing"

2.2.4.1 Impossible to Measure - "You can't measure what I do"

Divisions where work is of a non-routine nature and a data collection system does not exist will complain the loudest at performance measurement. They have survived this long without measuring, why start now? If the division could be measured, a system would already be in place. A starting place for determining what areas to measure lies in the answer to the question: "If your office closed shop for a few weeks, who would suffer the greatest impact, and what aspect of your work would they miss the most?" With this answer, acceptable performance measures can be easily developed.

2.2.4.2 Incorrect Measures - "You're measuring the wrong thing"

This argument usually is heard when the service providers are not consulted prior to developing performance measures. Insignificant indicators are being measured and more important dimensions are ignored. Communication between all levels in the organization is critical to ensure measurements are valid and that everyone understands the reasons behind the measurements.

2.2.4.3 Collection Economy - "It costs too much and we don't have the resources"

Economy of the data collection and the time required to collect and report are fundamental to a successful metric. Several companies have spent more effort and money collecting data than the money they have saved by using the results (Ammons 1995).

2.2.4.4 Ostrich Management - "I don't want to know how I am doing"

Some managers simply do not care or do not want to know how their operations are performing. They have the "See no evil, Hear no evil, Speak no evil" mindset and hope that by burying their head in the ground, all bad problems will disappear. These managers must be able to see the results of a measurement system before solid changes can take place.

2.3 Current Training

Currently PWD Keflavik is not training personnel on subject matter related to measurements of quality initiatives. Several years ago, PWD Keflavik began a push to educate personnel on the aspects of Total Quality Management. People attended training, but there was no plan for practicing the concepts learned in the classes when they returned to work. Recently PWD Keflavik has begun to develop a long range plan for the department and is utilizing teams to research the options available. Through the use of teams, the PWD

is seeing improvements, but this improvement is restricted due to insufficient training for the teams. More successful teams are ones that have a leader with a strong background and interest in TQ tools and techniques.

Peter Scholtes describes the four phases of team growth (forming, storming, norming, and performing) in The Team Handbook (Scholtes 1988). Unprepared teams frequently never make it past the storming stage in team growth. When the storm arrives, they abandon the ship, call the event a failure, and return to their old way of doing things. Successful teams move beyond the stage and eventually reach the performing stage with outstanding results. Metrics provide a sound basis for a successful team environment.

3. Methodology

In order to evaluate PWD Keflavik and develop meaningful metrics, the following methodology was used in this study.

3.1 Capture Existing Metrics

A two week site visit was conducted in May 1997 to examine the state of measurements at PWD Keflavik. One-on-one interviews were conducted with all nine division managers to understand the complexity of their organization. The interviews followed a basic pattern focused on using the SIPOC diagram as the foundation. This first step in the interview allowed each manager to clearly focus on what their division actually did before trying to address any measurement techniques. Understanding this process is the first step to improvement, with the second being process measurement. Appendix A contains SIPOC Diagrams for all nine divisions.

After the SIPOC was complete, a review of current measurements of conducted. Each interviewee was asked: Are they currently conducting any measurements? Have they seen a trend over the past year? Has there been an increase or decrease in the process time? Many of these questions were unanswerable since measurements did not exist. The few managers who still collected data either were not reporting to anyone or did not fully understand how to analyze the data generated to make future management decisions. These existing measurements were discussed to improve the method of presentation and analysis along with providing for a structured approach to measurement.

3.2 Review Required Metrics

While no formal metrics methodology exist for PWD Keflavik internally, several divisions do measure portions of their operations. Without a formal structure or requirement, the validity is questionable at best. In May of 1996, CINCLANTFLT developed a metrics program for shore installations called CINCLANTFLT Shore Installation Required Operational Capabilities Metrics. The external requirements have been in place for over a year now, but their use is ineffective for the PWD. These metrics are used at the CINCLANTFLT level to compare bases to each other, but the local bases are unable to use the information effectively since the delay in providing feedback from CINCLANTFLT to the local bases is excessive. Along with delayed feedback is the constantly changing political nature of the program without providing information to the providers of information. The latest change is the name of the program from "Metrics" to "Measures of Merit."

3.3 Develop Common Metrics

Since the metrics program for CINCLANTFLT fails to provide adequate feedback on operations for PWD Keflavik, improvement of existing measurements and development of new measurements is essential. Actual data from previous years was gathered to develop several new metrics. These data were discussed with the division directors to clarify the accuracy and create an understanding into the process. In an effort to normalize all the metrics between divisions, Tables of Standards (appendix B) were developed for each metric to provide a framework common to all measurements within Public Works.

4. Data Presentation and Analysis

SIPOC's developed for all nine divisions show the input and output to each process within the division. From process review of the SIPOC's, metrics were developed to measure the capability of the process . Existing metrics were refined and new metrics were created to develop an accurate presentation of the operations at PWD Keflavik.

4.1 SIPOC

Figure 4 shows a SIPOC diagram for the maintenance division of PWD Keflavik. As an example, one of Maintenance's processes is emergency and service calls. Base personnel submit trouble calls to PWD via the trouble desk. The input received by Maintenance is in the form of a printed work order (or phone call if on an emergency nature.) The other input Maintenance receives is material that comes from the Material Branch of PWD Keflavik. The output comes in the form of a repair to the broken item which satisfies the customer (Base personnel.)

Supplier	Input	Process	Output	Customer
605 - Maintenance				
Base residents Trouble Desk Material Branch	Phone call, printed record Construction material	Emergency Calls Service Calls	Repair	Base Personnel
FMED (P&E) Engineering Material Branch FSC	Job Order Package Designs Construction materials Assist contracts	Minor Projects (<48 hours) Specific Projects (>48 hours) Standing Job Orders	Construction or repair	Base Personnel
FMED Material Branch	PM Job orders, recurring work Construction materials	PMI / Recurring work	Maintenance & Repair	Base Personnel

Figure 4 - Example SIPOC for the Maintenance Division of PWD Keflavik

Table 1 provides reference for all the SIPOC diagrams located in Appendix A. The SIPOC's are broken down by PWD Keflavik Divisions. SIPOC Diagrams have multiple uses within an organization. Perhaps the most used application is improvement of processes. Many organizations focus on process improvement, but do not have a clear understanding of their processes. SIPOC defines these processes and forces the owners to set boundaries of these processes. These boundaries are the ranges of customers and suppliers along with inputs received and output generated.

The second use is to capture metrics. Measuring a process that is not related to an organization's processes is a waste of valuable resources. Metrics must somehow be a reflection of the SIPOC. For example, the Maintenance Division measures "leave predictability." This is not a processes itself, but it an indicator of all their processes since available labor is essential to their processes.

Communications breakdown can be avoided with quality SIPOC diagrams. Through the use of these accurate diagrams, various members of the organization can see where they fit into the roles as supplier and customer.

Lastly, the SIPOC's included can be further broken down to provide the level of detail necessary for the organization. They should also be updated regularly as processes and situations change. For example, pest control responsibility transferred from the Maintenance division to the Environmental division. Detail SIPOC diagrams should reflect these changes to avoid portraying an inaccurate picture of the organization.

Table 1 - SIPOC location in report

Division Code	***SIPOC Location***
601 - Fiscal/Personnel	Figure A.1
602 - Facilities Management Engineering	Figure A.2
603 - Engineering	Figure A.3
604 - Planning	Figure A.4
605 - Maintenance	Figure A.5
606 - Utilities	Figure A.6
607 - Transportation	Figure A.7
608 - Contracting	Figure A.8
60E - Environmental	Figure A.9

4.2 Metrics

Appendix B shows a complete list of metrics with their breakdown of standards. These standards provide for a normalization for all metrics. This approach attempts to eliminate irrelevant, non-cost effective measures and formally recognize those that are relevant. (Oswald 1992). Individual metrics are analyzed to include the following:

- Definition of what is being measured
- Justification for the measurement, including key result areas supported
- Description of all terms involved in the measure and units
- Sources of data
- Data presentation method, including chart type, software used
- Update cycle
- Responsibility for data collection, plotting analysis
- Distribution of updated charts
- Highest level of review
- Who is responsible for taking necessary control action
- Comments & summary

4.3 Refinement of Metrics

Keeping in mind the requirements for successful metrics, Table 2 provides reference for the PWD Keflavik metrics. Due to the number of metrics, Appendix B is divided into nine sections to correspond with the PWD divisions. Most metrics listed in Table 2 are self-explanatory or are a refinement of the existing measurement at PWD Keflavik. However, some require additional explanation since they are new to the system.

Table 2 - List of valid metrics for PWD Keflavik

Division Code	*Metric*	*Location*
601 - Fiscal Personnel		
	Work Year Utilization	Figure B1.1
	End Strength Utilization	Figure B1.2
	PWD Toll Costs	Figure B1.3
	PWD Overtime Utilization	Figure B1.4
	OPTAR P1	Figure B1.5
602 - Facilities Management Engineering		
	Long Range Plan - Investment Categories	Figure B2.1
	Customer Breakdown	Figure B2.2
	Variance Report (Delay causes) ✱	Figure B2.3
603 - Engineering		
	Design Effort Efficiency ✱	Figure B3.1
604 - Planning		
	Special Projects ✱	Figure B4.1
	Space Utilization	Table B4.2
605 - Maintenance		
	Shop Loading Predictability	Figure B5.1
	Priority Job Impact on Shop Load Plan	Figure B5.2
	Effect of leave planning on Shop Load Plan	Figure B5.3
	In-House Shop Forces Efficiency	Figure B5.4
	Foreman Delay Study	Figure B5.5
	Service calls completion time ✱	Figure B5.6
	Service calls backlog ✱	Figure B5.7
	Number of jobs using MS Project ✱	Figure B5.8
606 - Utilities		
	Electricity Use	Figure B6.1
	Water Use	Figure B6.2
	Geothermal Use	Figure B6.3
607 - Transportation		
	Total Down Time ✱	Figure B7.1
	Vehicle Turn-around time ✱	Figure B7.2
608 - Contracting		
	Invoice turn-around time ✱	Figure B8.1
	Contractor Performance Evaluation (annual)	Table B8.2
	Customer Satisfaction	Table B8.3
	Procurement Action Lead Time	Table B8.4
60E - Environmental		
	Hazardous Waste response time for pick-up ✱	Figure B9.1
	Spill response time ✱	Figure B9.2
	Construction Review ✱ (number of review/time for reviews)	Figure B9.3
	Water Quality Sample Collection (time sample received, collected / consistency in sample sites / customer sat)	Table B9.4

✱ Hypothetical Data - charts shown do not reflect real conditions

Work Delay Study - This measurement should be conducted monthly by surveying the foremen one day/week or for one week/month. After the data are collected and compiled into a summary report format, improvements can begin in areas that cause a considerable amount of delay for the shops.

Shop Load Variance/Delay - There are inevitable delays each month from the shop load plan. Understanding the reasons for delays is the beginning of improvement. Before the monthly Variance meeting, calculation of the percentages of delay by category (W - weather, L - labor availability (lack of), M - material, U - unforeseen conditions, S - customer change in scope, C - customer caused delay, O - other). Comparison of these percentages over the year will clearly reveal the areas where improvements can begin.

Engineering Efficiency - The engineering division accurately tracks hours spent on every aspect of engineering. Using this information to develop the unit costs for design work will allow them to benchmark their costs of work with private contractors.

Planning Efficiency - Simply measuring the number of estimates generated will not indicate the efficiency of the planning division. The unit measure (hours/estimate) will provide a better picture of the efficiency of the division personnel. Tracking of personnel hours (similar to the FMED and Engineering Division) will enable further development of effective measures for the planning division.

Vehicle Down-time - PC Transport software does not accurately calculate the downtime of vehicles. It is recommended to develop a meaningful measurement to

accurately show vehicle downtime for various vehicle categories. Another recommendation is to develop a similar measurement for vehicle turn-around time.

Customer Satisfaction for contracted work – Management should develop a short series of questions to ask random customers about the service they receive from contracted work. The information can then be compiled into a meaningful presentation. This qualitative measurement will provide additional insight into the regular inspections

Procurement Action Lead Time - The Contracting Officer and Contract Specialist should develop a schedule for procurement actions based on best available data. These actual dates for important milestones should then be tracked and compared with original schedule dates. An analysis is necessary to determine if actions are meeting anticipated target dates or if many actions are slipping and delaying the overall project. (Consult with Maintenance Division for help in using MS Project software to develop and use schedules for procurement items.)

4.4 Specific Findings

Two specific findings are discussed below concerning scheduling of shop forces. These findings are based on the data from the Actual Shop Load Plan from October 1995 to April 1997. These results are valid due to the fact they are based on objective data and cover a sufficient time period. Improving the conclusions is possible by monitoring and collecting additional data over the future time period.

Figure 5 shown below demonstrates the correlation of percentage available work-hours scheduled with percentage of shop load plan hours worked. A linear regression

indicates that the higher the percentage the plan is loaded, the less chance of meeting the plan is guaranteed. Using the actual past data, management must determine what "percent accomplished" they are satisfied with and schedule accordingly. If management wants a target of 95% accomplished, data indicates loading the plan to 80% of the available hours. If they desire to have the plan accomplished to 80%, then load the plan at 92% of available hours. Meeting the scheduled plan is desired since delays or jobs not worked must fall back to the next month and will have a ripple effect on numerous other jobs.

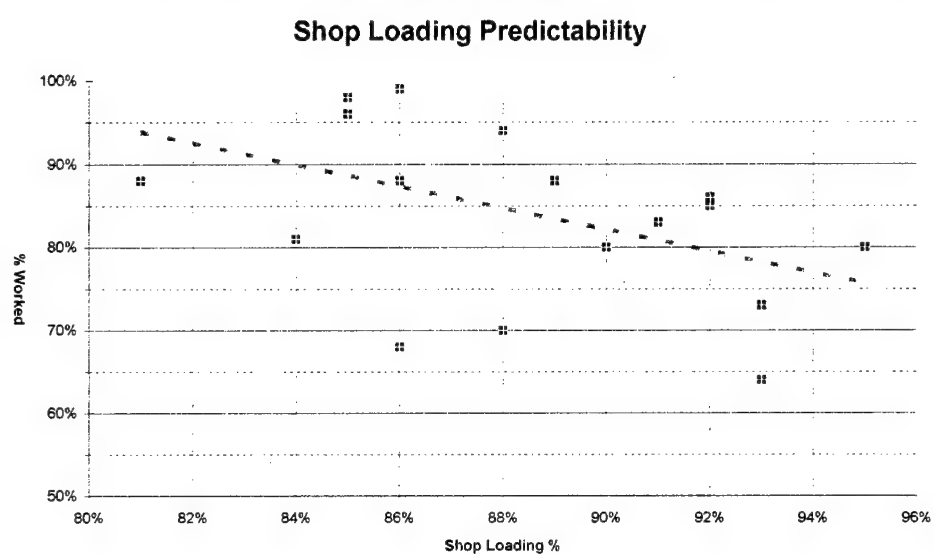


Figure 5 - Example of Shop Loading Predictability

The other important factor of shop load scheduling is the amount of hours spent on Priority Jobs. This chart is shown below in Figure 6. Data from the previous two years indicates that an average of 250 work hours per month are spent on priority jobs that were not originally on the Shop Load Plan. These numbers should be taken into consideration

when scheduling the monthly work. Ignoring the hours will not make the conditions disappear, but will only cause the jobs originally scheduled to be delayed. This ripple effect not only makes the scheduler's job more difficult, but causes customer inconvenience and irritation when their jobs are delayed.

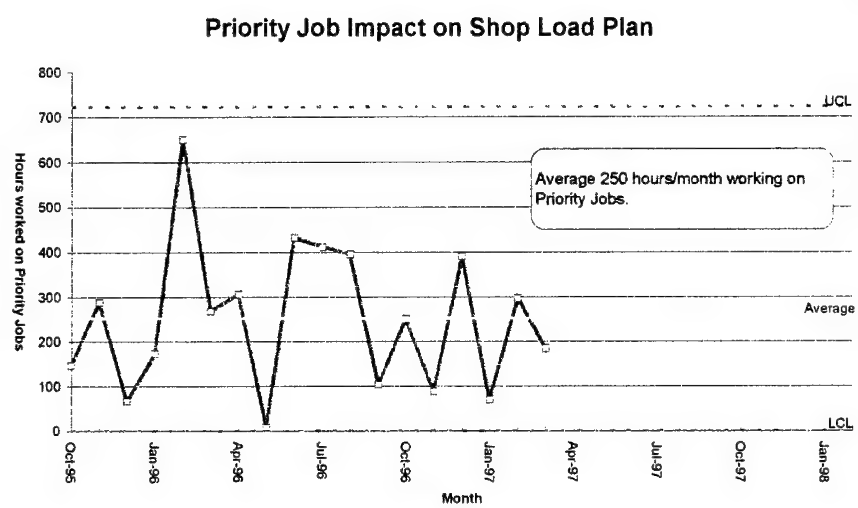


Figure 6 - Example of Priority Job Impact

The PWD Divisions should review their individual sections and improve upon the baseline presented here. Updating the SIPOC diagrams as processes change is vital in showing an accurate picture of the work within the divisions. The metrics presented are a starting point in understanding how to manage the future by using data from the past. The charts must be updated and reviewed continually if they are to be of any use. Training of personnel involved in the updating process is critical for continued improvement within the department.

5. Training

For the preceding metrics to become ingrained into the normal operations at PWD Keflavik, individuals must be trained in the use and knowledge of metrics. With the closing of the Quality Resource Center in Keflavik, PWD must develop its own in-house training course for the employees involved in the measuring process Table three lists the important features to be included in a training plan.

Table 3 - Training Course Schedule

Topics	***Attendees***	***Length***
Brief review of TQM/TQL principles Introduction to measuring techniques Measuring strategies Quality Tools (decision making) - Brainstorming, Tree diagram, SIPOC, Cause & Effect diagram Process Measuring Tools - Check sheet, Run chart, Control chart, Histogram, Scatter plot	Assistant Division Directors Any employee who will create and update charts	2 days
Brief review of TQM/TQL principles Overview of Process measuring tools Data analysis Planning through use of measurements	Division Directors	1 day
Suggested Sources for information:		
The Team Handbook (Scholtes 1988) The Memory Jogger Plus+ (Brassard 1989) The Memory Jogger II (Brassard 1994) Process Improvement Tools & Techniques (DON, no date)		

One aspect of the training involves constructing control charts. Control charts exist in many forms for different types of data. The "Individuals with a Moving Range" chart is the best format for measuring the type of work within Public Works Department since the data accumulates rather slowly and it is unable to be sub-grouped. Another advantage is that the individual charts are not sensitive to small shifts in the process average. The Memory Jogger II, published by GOAL/QPC provides excellent information on constructing control charts. Figure 6 shows an example of a control chart.

Various other chart types are shown in Appendix B. A scatter plot with a regression line is shown in Figure 5. A Histogram indicating a breakdown by various customers is shown in Figure B2.2. Figure B4.1 provides an example of a run chart. After more values are collected, control limits can be established and it can be converted into a control chart.

6. Conclusions & Recommendations

6.1 Conclusions

SIPOC diagrams for all nine divisions at PWD Keflavik were developed to provide an overall picture of the processes within the department. From these initial diagrams, metrics that met the criteria for successful metrics were created to measure the processes.

Through the use of the metrics and actual data gathered, interesting results were found concerning the scheduling of the maintenance shop forces. These results show how measurement tools must be used as a management tool for planning the future. Using the results as simply a history record is the same as riding a horse backwards: you have no idea where you are going, but you know exactly where you have been. Many hours were spent developing these metrics and it is management's task to use the information within their organization to continually improve their performance.

6.2 Recommendations

For any measurement program to have a chance of survival, it must be flexible and useable. Charts that hang on a wall and yellowed from age indicate management does not care and just simply went through the motions. With management firmly behind the program, the chances of success increase exponentially. Six recommendations for a successful program are:

<u>Anticipate resistance</u> – as with any change, there will always be individuals who fight it. Most of the resistance comes from ignorance of the new system and familiarity with the old.

Involve employees in developing the correct measures – one step in reducing resistance is to actively involve employees in developing the correct measures. Train them in data collection and analysis. (i.e., let them create the charts.) It is their process and they should have control of it.

Do both quantitative and qualitative analysis – Focusing only on quantitative measures can lead to erroneous mistakes, especially if the numbers are gamed or manipulated to make the organization look better. Along with focusing on numbers, add qualitative measures involving customer satisfaction. Talking with customers and employees adds additional insight to the organization's processes.

Subject measures to annual review and modification – Every year review the existing measures to determine the adequacy of the reporting technique. The decision should be made to keep as is, modify, or delete the measurement.

Do not use too many or too few measures – During the review process, care should be taken to ensure the right measures are used. Too few will not allow insight into the processes while too many will detract from the important issues.

Focus on maximizing the use of performance data – Good measurements do not guarantee successful management. Only when the managers integrate the results into their management style will the chance of improvement result. Managers must understand the importance of using measurements in forward-looking management when planning work, budgets, and reward systems.

Reviewing these six points will help a PWD's metrics program survive and grow through the years. Without these, the program will die after only one or two years. Consistent application of objective data to major decisions through the use of metrics will ensure PWD will continue to grow and improve its service to its internal and external customers.

Appendix A - SIPOC Diagrams

Supplier	Input	Process	Output	Customer
601 - Fiscal/Personnel				
Comptroller (CINCLANTFLT) LANTDIV (RPMA) Reimbursable customers	$$$$$	Budgeting Financial Planning Accounting	$$$$$$	PWD Divisions OPTAR Holders
Base Users NAS	$$$$$	Utility Purchase Agreement	Bills to customers	Base Users NAS
Comptroller (Manpower) Command Evaluation HRO	Work Years & End Strength Guidance	Personnel Support	Hiring, Firing, Travel, Training, PWD Roster, Summer Overhire	PWD Employees
Comptroller	$$, hardware, software	ADP Support	Tech support	PWD Divisions
FMED Comptroller	Bill of materials, Job orders $$$$$$	Material procurement & staging	Construction material	PW Maintenance Division

Figure A.1 - SIPOC Diagram for Fiscal / Personnel Division

Supplier	Input	Process	Output	Customer
602 - Facilities Management Engineering				
Base Customers	Phone call Work request	Work reception & control "PWMA" maintenance (Control) Filing & data gathering Customer Liaison	Job Order	In house force (Military & Civilian) Contractor (ROICC & FSC) Self-help
		Planning & Estimating	Bill of Material	Material Branch/Supply
P&E Inspectors (AIS)	Inspection Report	Work Packaging (Generated Work) Inspections Control Inspections (AIS) Special Inspections (boiler, roof, BOD)	AIS Report	Maintenance Action Plan Budget Execution Report
Comptroller	$$$$ Authorization	Funds Management MRP Budget	Spending execution plan	Report back to comptroller through 601
Base Customer	Work Requests	Work Planning Multi-year maintenance	Long range plan Shop load plan	Shops (Specific, minor, PMI)
			Contract execution plan (FSC)	Engineering, FSC, ROICC
			Special project preparation	Engineering, Planning
Base Customers	Request for assistance	Self-help	Authorization	Self-help shop
Shops, comptroller, P&E	$$$, hours	Analysis & productivity	Variance report, EPS report	PWO

Figure A.2 - SIPOC Diagram for Facilities Management Engineering Division

Supplier	Input	Process	Output	Customer
603 - Engineering				
Base Customers	Funds, scope, requirements	Designing	Completed design for ROICC or Shops	Base Customers FMED
Regulatory Agencies Safety Environmental Fire Industrial Hygienist etc.	Review of designs & specifications	Contract Specification Writing	FSC Contracts	
PWO/APWO/601	$$$$ Equipment	Technical consulting	Reviews Papers Recommendations Memos & briefs Word of advice	
		General support	Copies of maps	
		Estimating	Budget estimates	

Figure A.3 - SIPOC Diagram for Engineering Division

Supplier	Input	Process	Output	Customer

604 - Planning

AIS/BASEREP/Customer NATO, maintenance & readiness inspection External customers	Needs, mission changes	Project Documentation Special projects NATO MILCON		Major Claimant IDF, Atlantic Command, NATO CINCLANTFLT, NAVFAC
Base commands, ROICC completion of contract		Property Record Files	Change of record card	LANTDIV
External customers	Written justification	Space Utilization / Demo		Base customer
		CINCLANTFLT budget	Budget figures	601
P&E (AIS Inspector)	Facility report & estimate	AIS Coordination (proj documentation)		
Every command , NAS Depts	Facility & Equipment quantity & condition, personnel quantity	BASEREP compilation (annual)	Completed report	CINCLANTFLT
Billeting Officer	Barracks condition (R21) Body count (R19)	BEQ quantity / condition reports (R19, R21) (annual)	Completed report	LANTDIV (08)
		Baseloading (Classified)		LANTDIV (08)

Figure A.4 - SIPOC Diagram for Planning Division

605 - Maintenance

Supplier	Input	Process	Output	Customer
FMED (Trouble Desk) Base residents Material Branch	Phone call, printed record Construction material	Emergency Calls Service Calls	Repair	Base Residents (Every one on base)
FMED (P&E) Engineering Material Branch FSC	Job Order Package Designs Construction materials Assist contracts	Minor Projects (<48 hours) Specific Projects (>48 hours) minor construction repair maintenance Standing Job Orders	Construction or repair	
FMED Material Branch	PM Job orders, recurring work Construction materials	PMI / Recurring work	Maintenance & Repair	

Figure A.5 - SIPOC Diagram for Maintenance Division

Supplier	Input	Process	Output	Customer
606 - Utilities				
Sudenes Regional Heating Company	Hot water to base	Geothermal Heat Distribution	Heating to buildings	Base Residents (Everyone on base)
Sudenes Regional Heating Company Base Power Plant	Electricity (50Hz) to base	Electricity Conversion (60Hz) and Distribution	KWH	
Sudenes Water Works Base Water Plant	Water to base	Water Distribution	Potable Water	

Figure A.6 - SIPOC Diagram for Utilities Division

Supplier	Input	Process	Output	Customer
607 - Transportation				
TEMC / CESO & Leases DRMO Air Force	Vehicles	Assign Vehicles		Base Customers
People w/ vehicles Supply / VSB FSC Credit Card - purchase	Broken vehicles Parts	Repair & maintain vehicles	Work repair, maintenance	Base Customers
FMED Engineering Environmental	Job Order SJO	Operate Vehicles (Heavy Equipment)	Actual work, garbage, snow removal, towing	Base Customers
Those who need people licensed		Licensing	Written & driving testing, training	Base residents/ anyone who want to drive on base

Figure A.7 - SIPOC Diagram for Transportation Division

Supplier	Input	Process	Output	Customer

608 - Facility Support Contracts

FMED Engineering	Contract requirement documents	Facility Contracts Solicitation (sealed bid or negotiate)	Award contract	Base Users
Contractor	Service or work in place	Contract administration	Quality assurance/inspection	Base User

Figure A.8 - SIPOC Diagram for Contracts Division

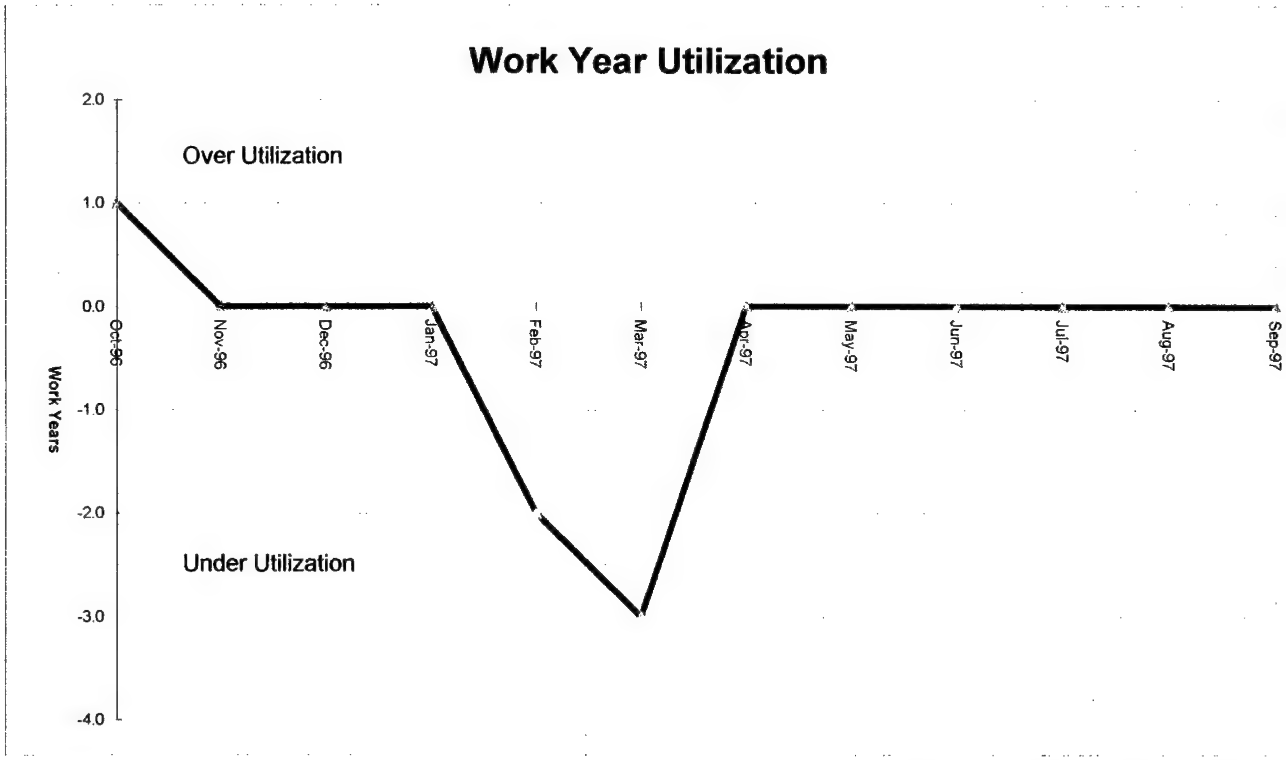
Supplier	Input	Process	Output	Customer
60E - Environmental				
Base residents, NEX Transportation shops & other generators	Used oil, batteries, household chemicals	Pollution prevention / recycling	Consolidated products Reports	DRMO / CHRIMP (Back to base residents)
CHRIMP Generators	Used Haz waste products	Haz waste packaging & disposal	Consolidated products Reports	DRMO CINCLANTFLT
Planning, Engineering, ROICC	Design documents	Construction review / NEPA documentation	Comments	Planning, Engineering, ROICC
Exercise planners		Exercise plan review	Environmental annex in OP order or exercise guidance	Exercise participants
Customer complaints, regulatory agencies requirements for sampling	Water samples	Water quality testing	Report to correct or actual correction	Base user CINCLANTFLT
ODS: Solvents, CFC's, halons		Air quality testing	Consolidated products, report	DRMO
Management Plan	Testing inspections	Tank management (abandoned, current use, future use)	Report, tank construction project	Base user Regulatory compliance
Incinerator Residents, Local community Public Works	Ash Trash Bulky waste	Solid waste management	Solid waste report	Base CO, Local community, health & hygiene
Airfield & regulatory agencies, Host nation	Airfield requirements	Natural resources management Revegetation Bird air strike program	Planting	Airfield users (civ & military) Base C.O. & residents
Keflavik Contractors Other Contractors, PW shops	Contained asbestos	Asbestos disposal	Log & report	CINCLANTFLT Base safety
Generators on base DRMO, closure process	Discovered contaminant	Restoration	Remediate or health risk assessment	Base C.O. Regulatory requirements
3 Tier evaluation process	Inspections, ECE, management plans, CINCLANTFLT	Financial planning, obligation	Budget requirements, A106	CINCLANTFLT
Regulatory agency	Regulation	Compliance Inspections: Self-inspection, Fleet inspection, IG inspection	Findings	CINCLANTFLT
Operators	Fuel spills Other spills (occasional)	Spill response	Clean up & Report	Base C.O. Regulatory requirements
User management plan	Testing & inspection	Waste water	Cleaning oil/water separator Construction project Report / recommendation of action	Base residents

Figure A.9 - SIPOC Diagram for Environmental Division

Appendix B1 - Fiscal/Personnel Division Metrics

Table B1.1 - Work Year Utilization

Metric	Work Year Utilization
Definition of what is being measured and in what units of measure	Measure of staffing levels at PWD. Work years set by Comptroller
Justification for the measurement. Key result areas supported	Resource Utilization
Description. Definition of all terms involved in the measure	Work Year - One person working for One year at PWD
Sources of data	Comptroller
Data presentation method. Chart type, software used	Run Chart Excel
Update cycle	Monthly
Responsibility for data collection, plotting analysis	Financial Manager
Distribution of updated charts	PWO/APWO
Highest level of review	PWO
Who is responsible for taking necessary control action	Administrative Officer
Comments and summary:	Under - indicates staffing below target, ability to hire more employees Over - indicates staffing above target and will result in over commitment at end of fiscal year unless corrective action is taken.



	Oct-96	Nov-96	Dec-96	Jan-97	Feb-97	Mar-97	Apr-97	May-97	Jun-97	Jul-97	Aug-97	Sep-97
Authorized	22	45	67	90	112	135	157	180	202	225	247	270
Used	23	45	67	90	110	132						
Over/Under	1	0	0	0	-2	-3	0	0	0	0	0	0

Figure B1.1 - Example of Work Years Tracking

Table B1.2 - End Strength

Metric	End Strength
Definition of what is being measured	End strength (number of people employed in Public Works at the end of the month/year)
Justification for the measurement. Key result areas supported	Cost Management and Resource Utilization
Description. Definition of all terms involved in the measure and units	Authorized: Level set by Comptroller Used: Current staffing level Units - Number of employees
Sources of data	Comptroller, In-house records
Data presentation method. Chart type, software used	Run Chart Excel
Update cycle	Monthly update
Responsibility for data collection, plotting analysis	Financial Manager
Distribution of updated charts	PWO/APWO/Shops Engineer/ all divisions in PW
Highest level of review	PWO
Who is responsible for taking necessary control action	PWO/APWO/ Administrative Officer
Comments and summary:	Trends clearly show the authorized end strength and amount used to date. Multiple years indicate down sizing over the past years.

End Strength Utilization

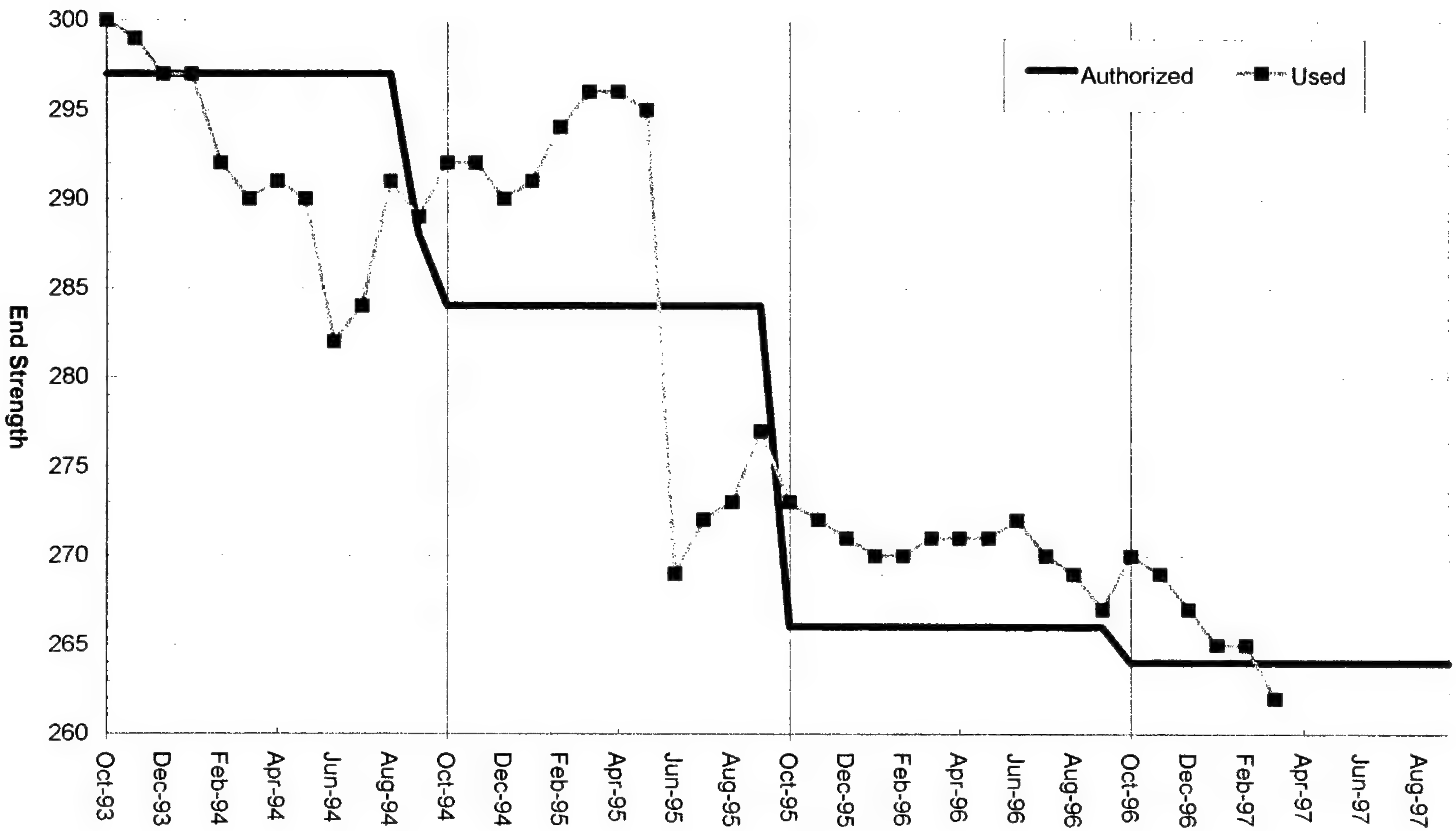
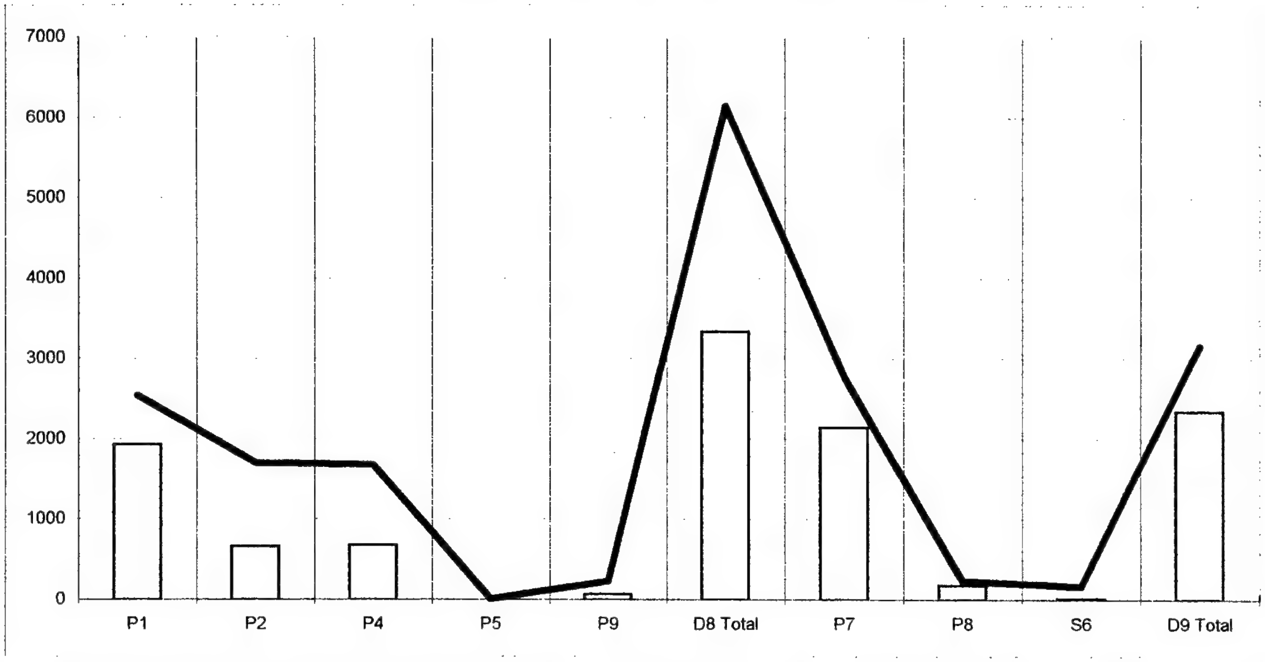


Figure B1.2 - Example of End Strength Utilization

Table B1.3 - Overtime Utilization

Metric	Overtime Utilization
Definition of what is being measured	Overtime usage at PWD broken into labor categories
Justification for the measurement. Key result areas supported	Cost Management and Resource Utilization
Description. Definition of all terms involved in the measure and units	P1-D9 - Budget categories Authorized - hours authorized by comptroller Used - actual hours used to date Norm - target % to date Units - hours
Sources of data	Comptroller
Data presentation method. Chart type, software used	Histogram with line indicating upper limits Excel
Update cycle	Monthly update
Responsibility for data collection, plotting analysis	Financial Manager
Distribution of updated charts	PWO/APWO/Shops Engineer/ all divisions in PW
Highest level of review	PWO
Who is responsible for taking necessary control action	Division directors
Comments and summary:	Individual labor categories are broken out. The norm% indicates the target amount for the year to date.

Overtime Utilization FY97



Hours	P1	P2	P4	P5	P9	D8 Total	P7	P8	S6	D9 Total
Authorized	2536	1700	1677	4	224	6141	2768	231	162	3161
Used	1931	660	676	0	68	3335	2145	180	20	2345
% Used	76%	39%	40%	0%	30%	54%	77%	78%	12%	74%

Norm:	64%

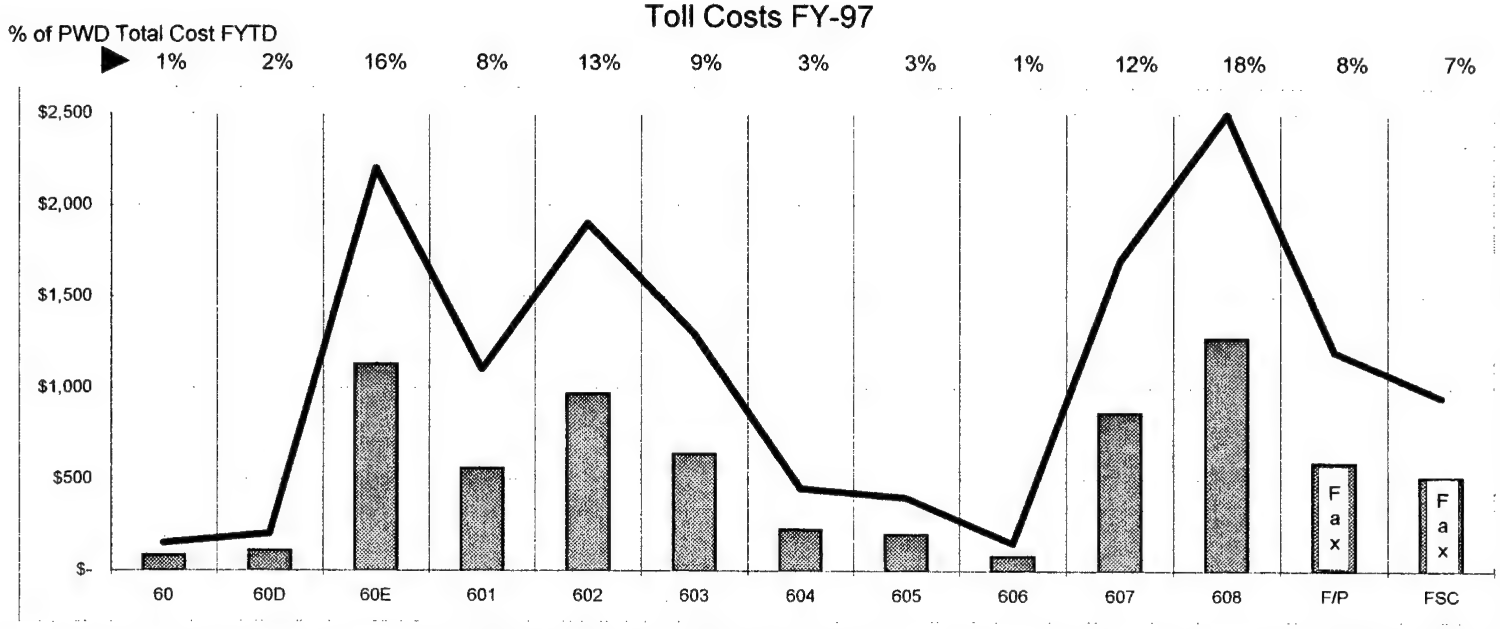
Figure B1.3 - Example of Overtime Utilization

Table B1.4 - Toll Costs

Metric	Toll Costs
Definition of what is being measured	Long distance telephone call use
Justification for the measurement. Key result areas supported	Cost Management
Description. Definition of all terms involved in the measure and units	Ceiling - $$ authorized Used - actual $$ used to date Authorization - Total $$ authorized for PW Actual cost FYTD - $$ used to date Norm - scheduled target Used - % used to date Units - $$
Sources of data	NCTS Telephone branch
Data presentation method. Chart type, software used	Histogram with line indicating upper limits Excel
Update cycle	Monthly update
Responsibility for data collection, plotting analysis	Financial Manager
Distribution of updated charts	PWO/APWO/Shops Engineer/ all divisions in PW
Highest level of review	PWO
Who is responsible for taking necessary control action	All division directors
Comments and summary:	Tracking of PWD long distance calls by division. Percentage on top of graph shows each division's percentage of total PWD costs. Norm % indicates the target amount for year to date.

PWD

Toll Costs FY-97



	60	60D	60E	601	602	603	604	605	606	607	608	F/P	FSC
Ceiling	150	200	2200	1100	1900	1300	450	400	150	1700	2500	1200	950
Used	83	110	1129	560	968	641	226	198	81	865	1274	593	514
% Used	55%	55%	51%	51%	51%	49%	50%	50%	54%	51%	51%	49%	54%

Authorization:	$ 14,200
Actual Cost FYTD:	$ 7,242

Norm:	50%
Used:	51%

Figure B1.4 - Example of Long Distance Usage

Table B1.5 - OPTAR P1 Tracking

Metric	OPTAR P1 Tracking
Definition of what is being measured	Tracking of OPTAR P1 for PWD
Justification for the measurement. Key result areas supported	Cost Management
Description. Definition of all terms involved in the measure and units	OPTAR - Operation Target P1 - PW budget for other engineering support Authorization - Amount set by Comptroller Committed - $$ spent by PW
Sources of data	Comptroller
Data presentation method. Chart type, software used	Run Chart Excel
Update cycle	Monthly update
Responsibility for data collection, plotting analysis	Financial Manager
Distribution of updated charts	PWO/APWO/Shops Engineer/ all divisions in PW
Highest level of review	PWO
Who is responsible for taking necessary control action	PWO/APWO/ Administrative Officer
Comments and summary:	Authorized money doesn't arrive in a linear fashion. The authorization line shows the trend of money being delayed until the third and fourth quarter. Tracking the committed funds shows the over or under obligation

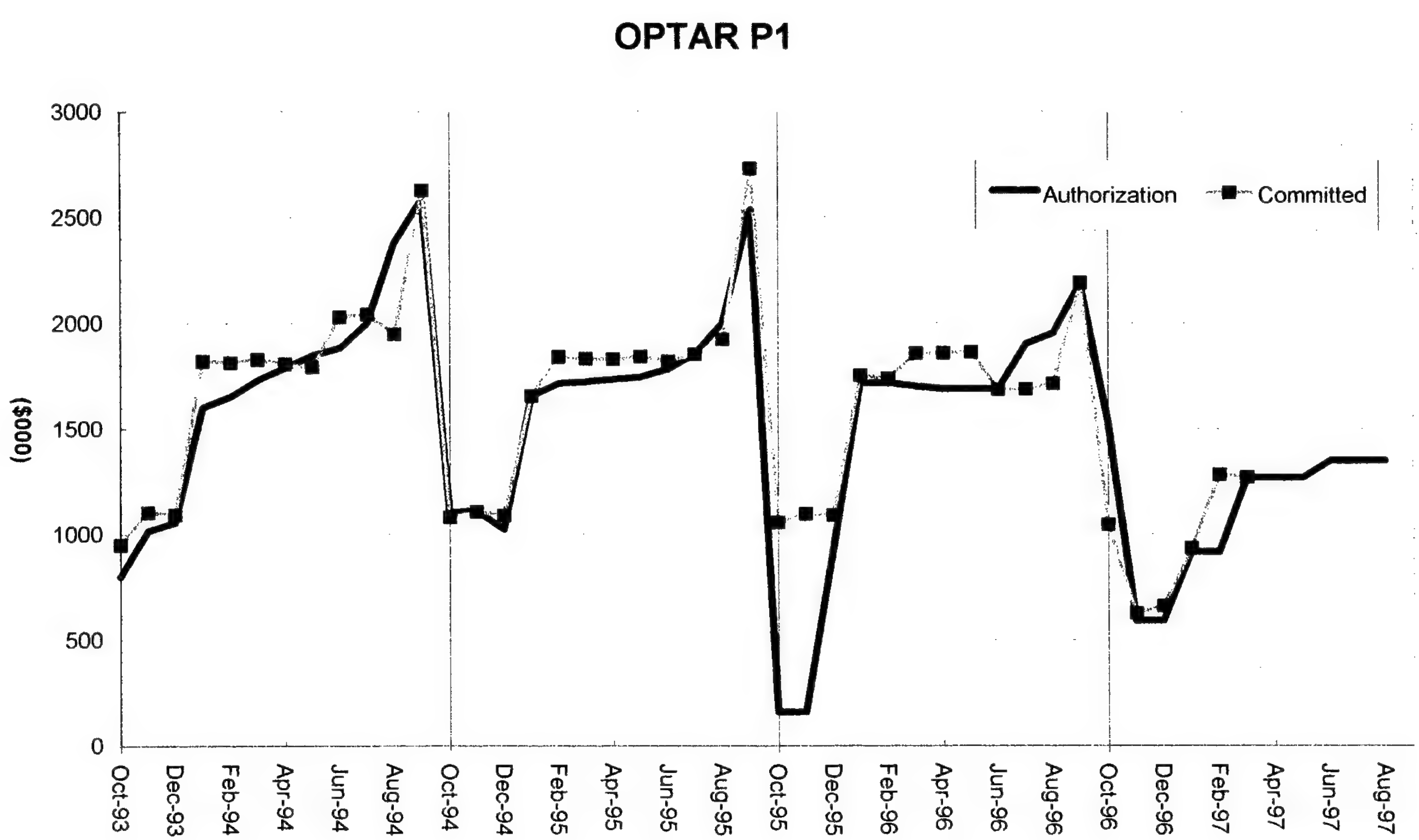
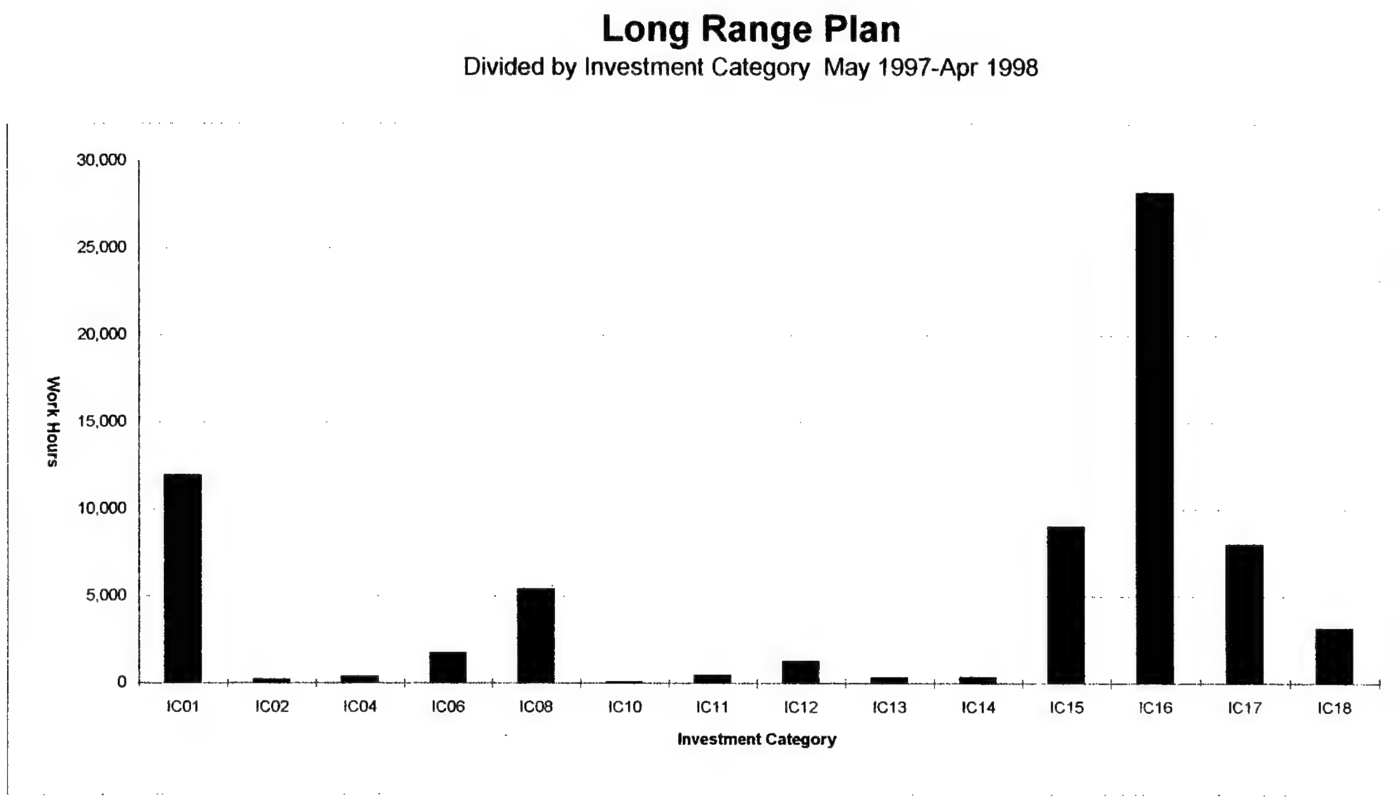


Figure B1.5 - Example of OPTAR Tracking for P1 Budget

Appendix B2 - Facilities Management Engineering Metrics

Table B2.1 - Long Range Maintenance Plan Investment Categories

Metric	Long Range Maintenance Plan Investment Categories
Definition of what is being measured	Number of hours devoted to Navy's investment categories
Justification for the measurement. Key result areas supported	Cost Management and Resource Utilization
Description. Definition of all terms involved in the measure and units	IC - Investment category code Hours - number of hours dedicated to maintenance and repair Units - Work hours
Sources of data	Comptroller, In-house records
Data presentation method. Chart type, software used	Histogram grouped by IC Excel
Update cycle	Annual update
Responsibility for data collection, plotting analysis	602A
Distribution of updated charts	PWO/APWO/Shops Engineer/ all divisions in PW PW Customers
Highest level of review	PWO
Who is responsible for taking necessary control action	PWO/APWO/Facilities Management Engineering Director
Comments and summary:	



Hours	11917	182	347	1702	5363	63	433	1231	294	320	8972	28177	7975	3131
%	17.0%	0.3%	0.5%	2.4%	7.6%	0.1%	0.6%	1.8%	0.4%	0.5%	12.8%	40.2%	11.4%	4.5%
	IC01	IC02	IC04	IC06	IC08	IC10	IC11	IC12	IC13	IC14	IC15	IC16	IC17	IC18

Figure B2.1 - Long Range Plan categorized by Investment Categories

Table B2.2 - Long Range Maintenance Plan Base customers

Metric	Long Range Maintenance Plan Base customers
Definition of what is being measured	Number of hours devoted to Base customers
Justification for the measurement. Key result areas supported	Cost Management and Resource Utilization
Description. Definition of all terms involved in the measure and units	Customers - Commands and NAS departments which receive services from PW Hours - number of hours dedicated to maintenance and repair Units - Work hours
Sources of data	Comptroller, In-house records
Data presentation method. Chart type, software used	Histogram grouped by customer Excel
Update cycle	Annual update
Responsibility for data collection, plotting analysis	602A
Distribution of updated charts	PWO/APWO/Shops Engineer/ all divisions in PW PW Customers
Highest level of review	PWO
Who is responsible for taking necessary control action	PWO/APWO/ Facilities Management Engineering Director
Comments and summary:	

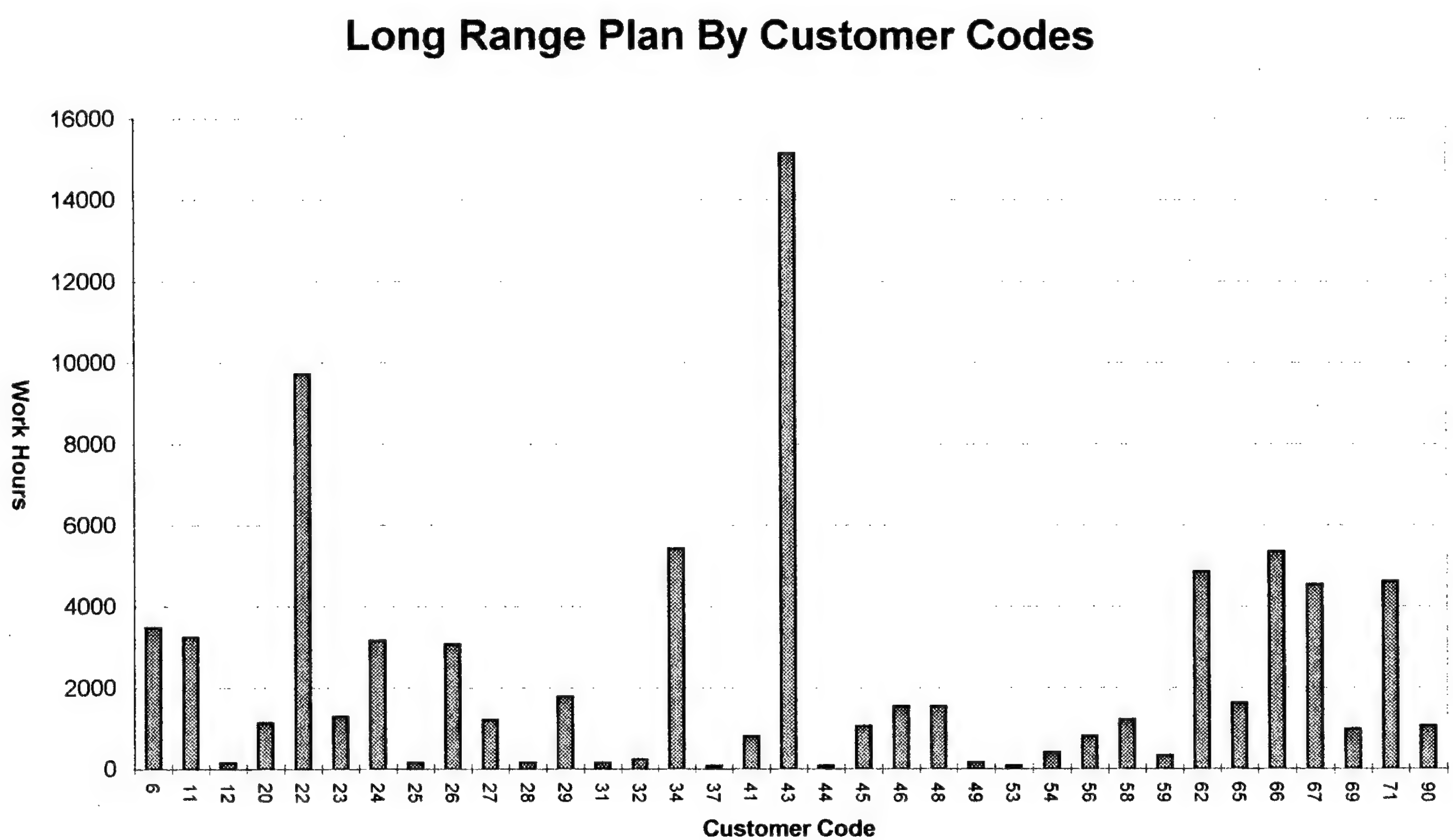


Figure B2.2 - Long Range Plan categorized by Customer Codes

Table B2.3 - Causes of Delay (Variance)

Metric	Causes of Delay (Variance)
Definition of what is being measured	Summary of Delays from Shop Load plan work schedule.
Justification for the measurement. Key result areas supported	Cost Management and Resource Utilization
Description. Definition of all terms involved in the measure and units	Causes of Delay W - weather L - labor availability (lack of) M - material U - unforeseen conditions S - customer change in scope C - customer caused delay O - other
Sources of data	Shop Load plan and Production Controller
Data presentation method. Chart type, software used	Histogram Excel
Update cycle	Monthly (discuss at variance meeting)
Responsibility for data collection, plotting analysis	Production Controller, 602A
Distribution of updated charts	PWO/APWO/Shops Engineer/ Facilities Management Engineering Director/ Maintenance Division Director
Highest level of review	PWO
Who is responsible for taking necessary control action	Shops Engineer, Facilities Management Engineering Director, Maintenance Division Director
Comments and summary:	hypothetical data - actual not available

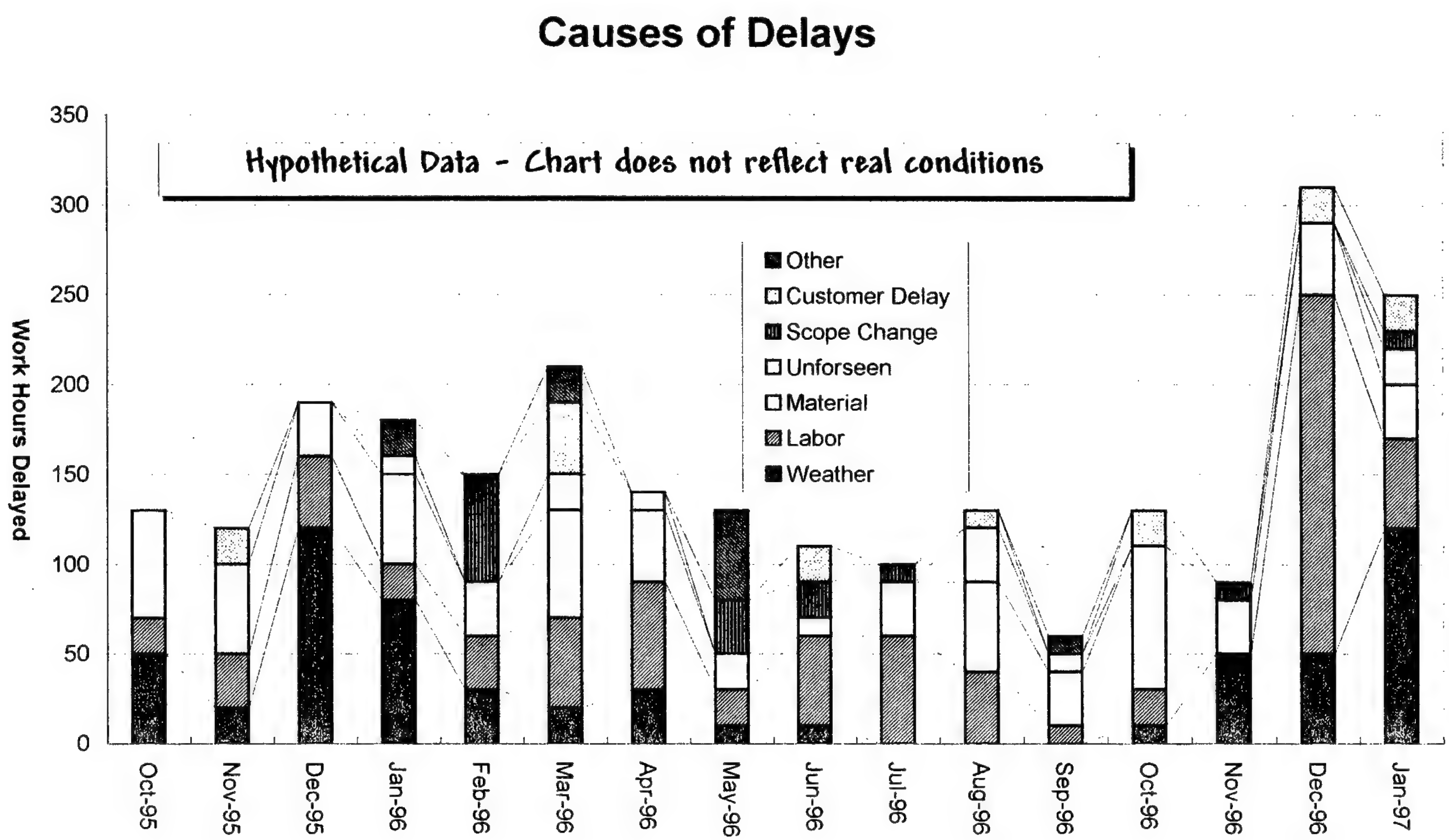


Figure B2.3 - Example of Causes of Delay Analysis

Appendix B3 - Engineering Metrics

Table B3.1 - Engineering Design

Metric	Engineering Design
Definition of what is being measured	PW Engineering design efficiency
Justification for the measurement. Key result areas supported	Resource Utilization
Description. Definition of all terms involved in the measure and units	Design $$ - estimated construction costs to construct the project. Hours and costs for the design effort are accounted separately Design and Tech hours - work hours by engineers and technicians on projects Units - ($$ Cost Estimated) / (Design + Tech hours)
Sources of data	In-house records
Data presentation method. Chart type, software used	Run Chart (Control Chart later) Excel
Update cycle	Quarterly update
Responsibility for data collection, plotting analysis	Engineering Division Director
Distribution of updated charts	PWO / APWO / Engineering Division Director
Highest level of review	PWO / APWO / Engineering Division Director
Who is responsible for taking necessary control action	Engineering Division Director
Comments and summary:	Units show Ratio of Cost Estimated $$ to design hours. Higher numbers reflect better efficiency (i.e. more design for less work hours) If this ratio is ambiguous, develop another, but make sure the figures include efficiency and not simply workload measurements. hypothetical data - actual not available

Hypothetical Data

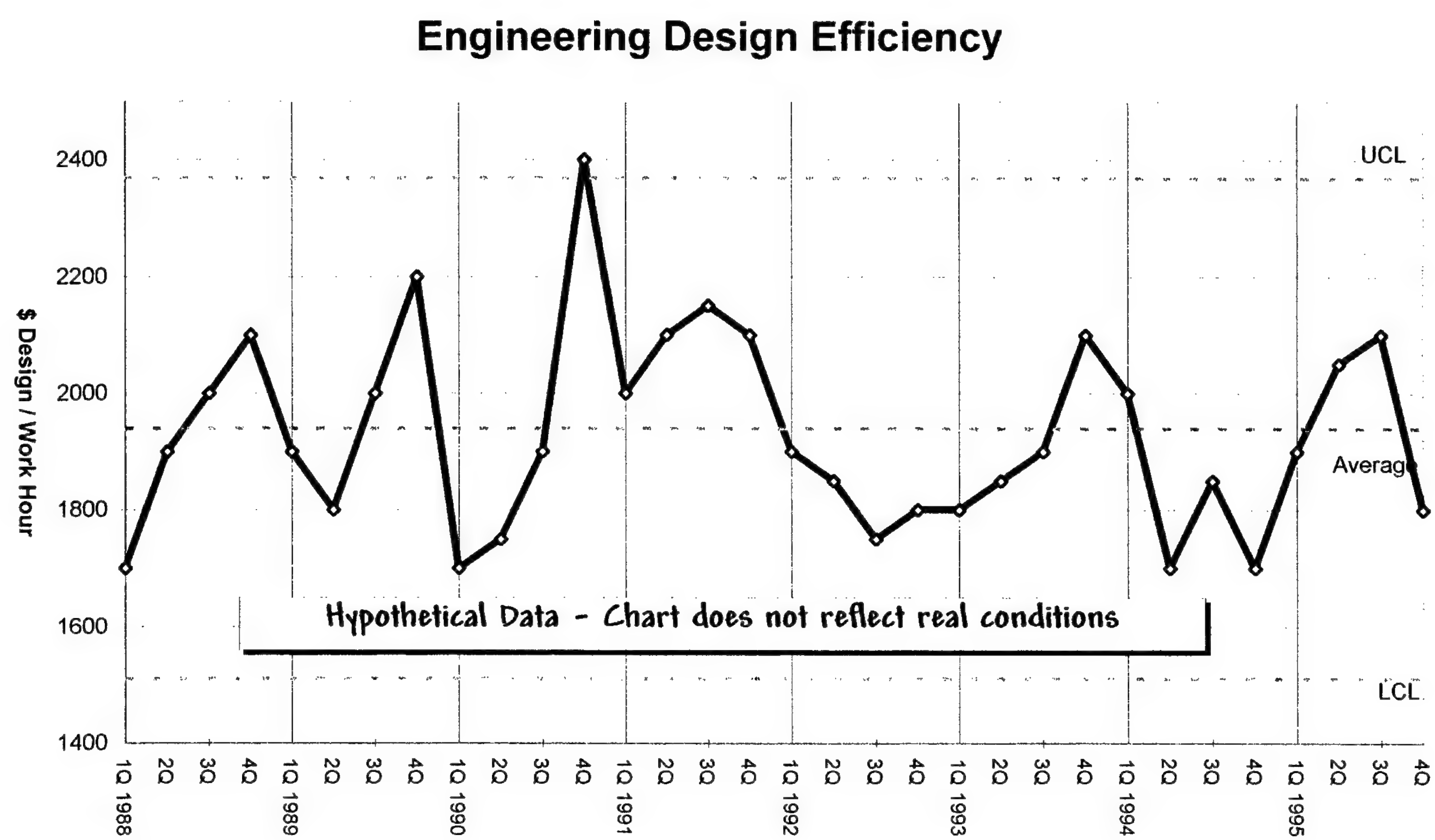


Figure B3.1 - Example of Engineering Design Efficiency

Appendix B4 - Planning Metrics

Table B4.1 - Special Project Documentation

Metric	Special Project Documentation
Definition of what is being measured	Completion of special project documentation
Justification for the measurement. Key result areas supported	Cost Management and Resource Utilization
Description. Definition of all terms involved in the measure and units	Number of projects - Special project packages completed during Fiscal year Hours - total hours spent on projects Units - each package
Sources of data	In-house records
Data presentation method. Chart type, software used	Control Chart Excel
Update cycle	Annual update
Responsibility for data collection, plotting analysis	Planning Division Director
Distribution of updated charts	PWO / APWO / Facilities Management Engineering Director / Engineering Division Director / CINCLANTFLT
Highest level of review	PWO
Who is responsible for taking necessary control action	Planning Division Director
Comments and summary:	Current trend measures output from division. (Workload measurement) Recommend changing to efficiency measurement by calculating: # estimates/total hours worked on estimates. hypothetical data - actual not available

Hypothetical Data

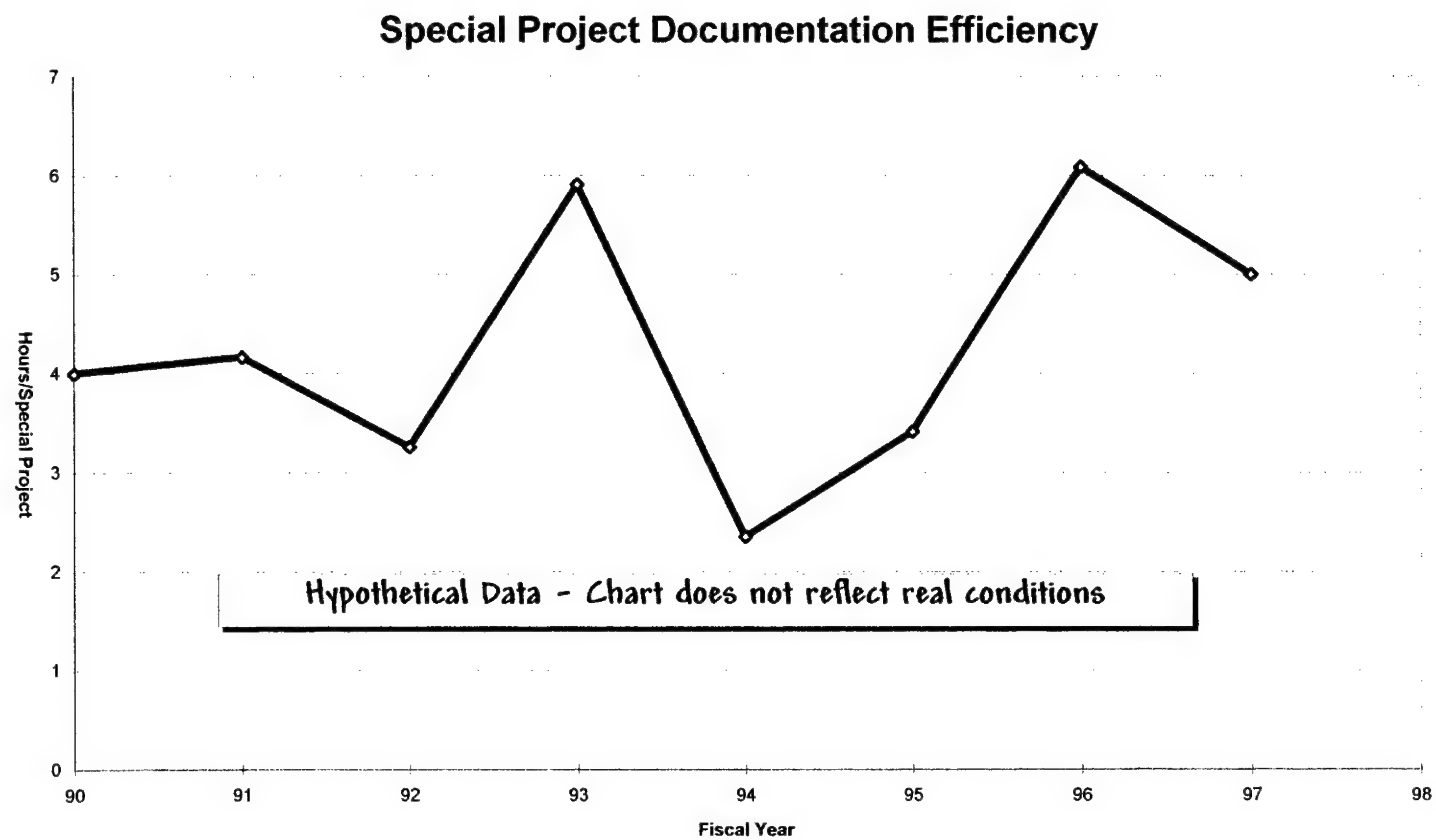


Figure B4.1 - Example of Special Project Documentation Efficiency

Table B4.2 - Space Utilization

Metric	Space Utilization
Definition of what is being measured	Tracking of relocation and space requests by base commands and departments
Justification for the measurement. Key result areas supported	Resource Utilization
Description. Definition of all terms involved in the measure and units	
Sources of data	Existing database
Data presentation method. Chart type, software used	Currently no method
Update cycle	As-necessary (at least quarterly)
Responsibility for data collection, plotting analysis	Planning Division Director
Distribution of updated charts	NAS Executive Officer, PWO, APWO, Planning Division Director
Highest level of review	NAS Executive Officer
Who is responsible for taking necessary control action	NAS Executive Officer, PWO, Planning Division Director
Comments and summary:	Space utilization report is generated after each utilization meeting. Listed are requests granted, put on hold, and rejected. Compile the actions into groups by command.

Appendix B5 - Maintenance Metrics

Table B5.1 - Shop Loading Predictability

Metric	Shop Loading Predictability
Definition of what is being measured	Predictability of Shop Load Plan actually worked based on the level of loading
Justification for the measurement. Key result areas supported	Cost Management and Resource Utilization
Description. Definition of all terms involved in the measure and units	Shop loading % - percentage of total estimated available work hours for the month % Worked - percentage of shop loaded hours worked for the month
Sources of data	Shop Load Plan, labor distribution cards
Data presentation method. Chart type, software used	Scatter diagram Excel
Update cycle	Quarterly
Responsibility for data collection, plotting analysis	Maintenance Division Director, Production Controller
Distribution of updated charts	PWO / APWO / Shops Engineer / Facilities Management Engineering Director
Highest level of review	PWO
Who is responsible for taking necessary control action	Shops Engineer, Maintenance Division Director, Facilities Management Engineering Director
Comments and summary:	Scatter plot indicates that the more the plan is loaded to maximum, the less like the chance of having it worked to the maximum is. Continue to collect data to determine stronger correlation.

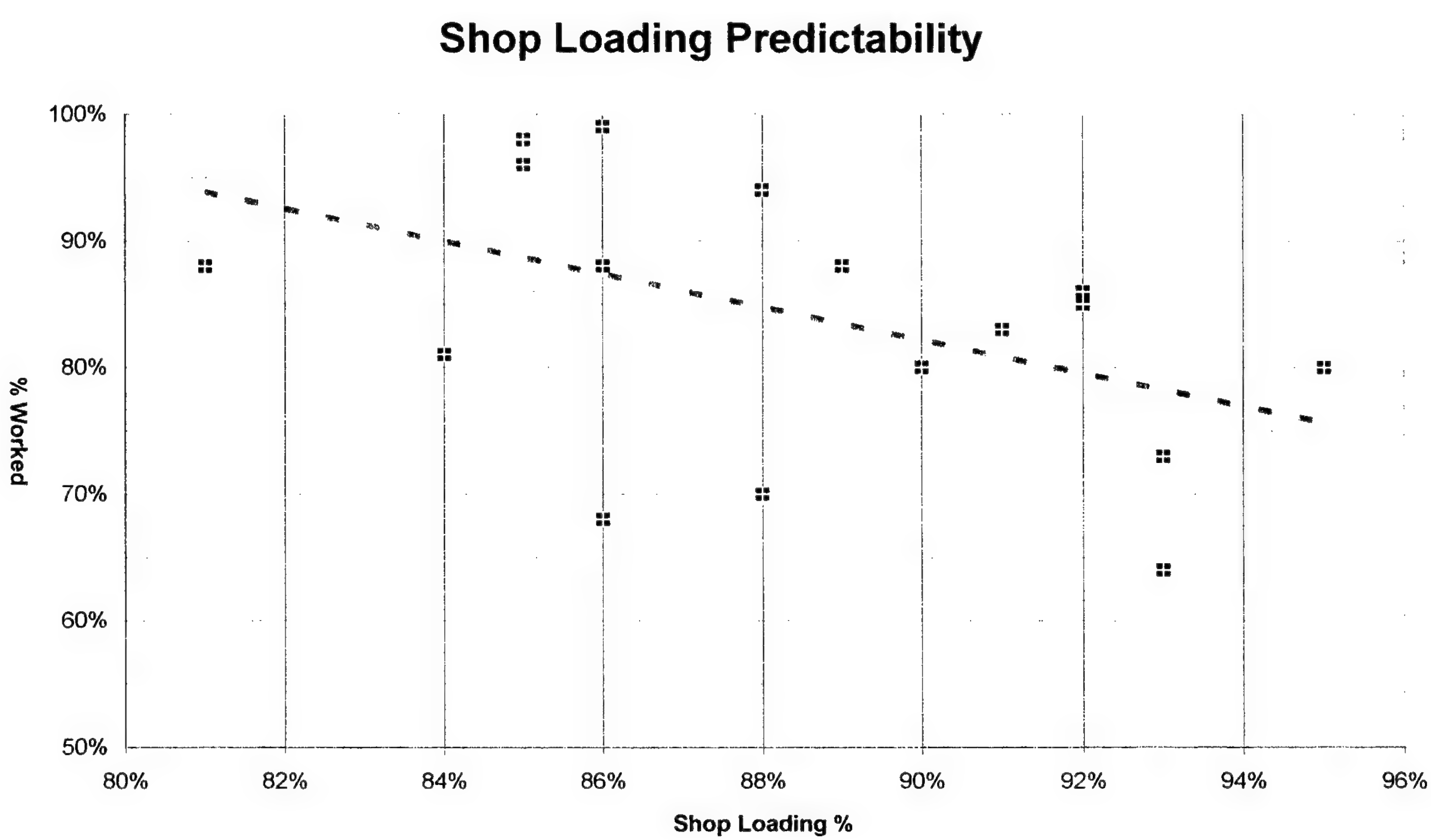


Figure B5.1 - Example of Scatter Plot for Shop Load Plan Predictability

Table B5.2 - Priority Job Impact

Metric	Priority Job Impact
Definition of what is being measured	Delays in original shop load plan due to unforeseen priority jobs.
Justification for the measurement. Key result areas supported	Cost Management and Resource Utilization
Description. Definition of all terms involved in the measure and units	Priority Jobs - Commanding Officer interest jobs, Other requests from Higher HQ, Storm damage or other jobs requiring immediate attention Units - Work hours
Sources of data	605A labor distribution and time cards
Data presentation method. Chart type, software used	Control Chart Excel
Update cycle	Monthly
Responsibility for data collection, plotting analysis	Maintenance Division Director, Production Controller
Distribution of updated charts	PWO / APWO / Shops Engineer / Facilities Management Engineering Director
Highest level of review	PWO
Who is responsible for taking necessary control action	PWO, Shops Engineer, Maintenance Division Director
Comments and summary:	Average hours spent on priority jobs must be figured into the shop load plan estimate. Ignoring this amount of hours will only lead to failure in meeting the shop load plan

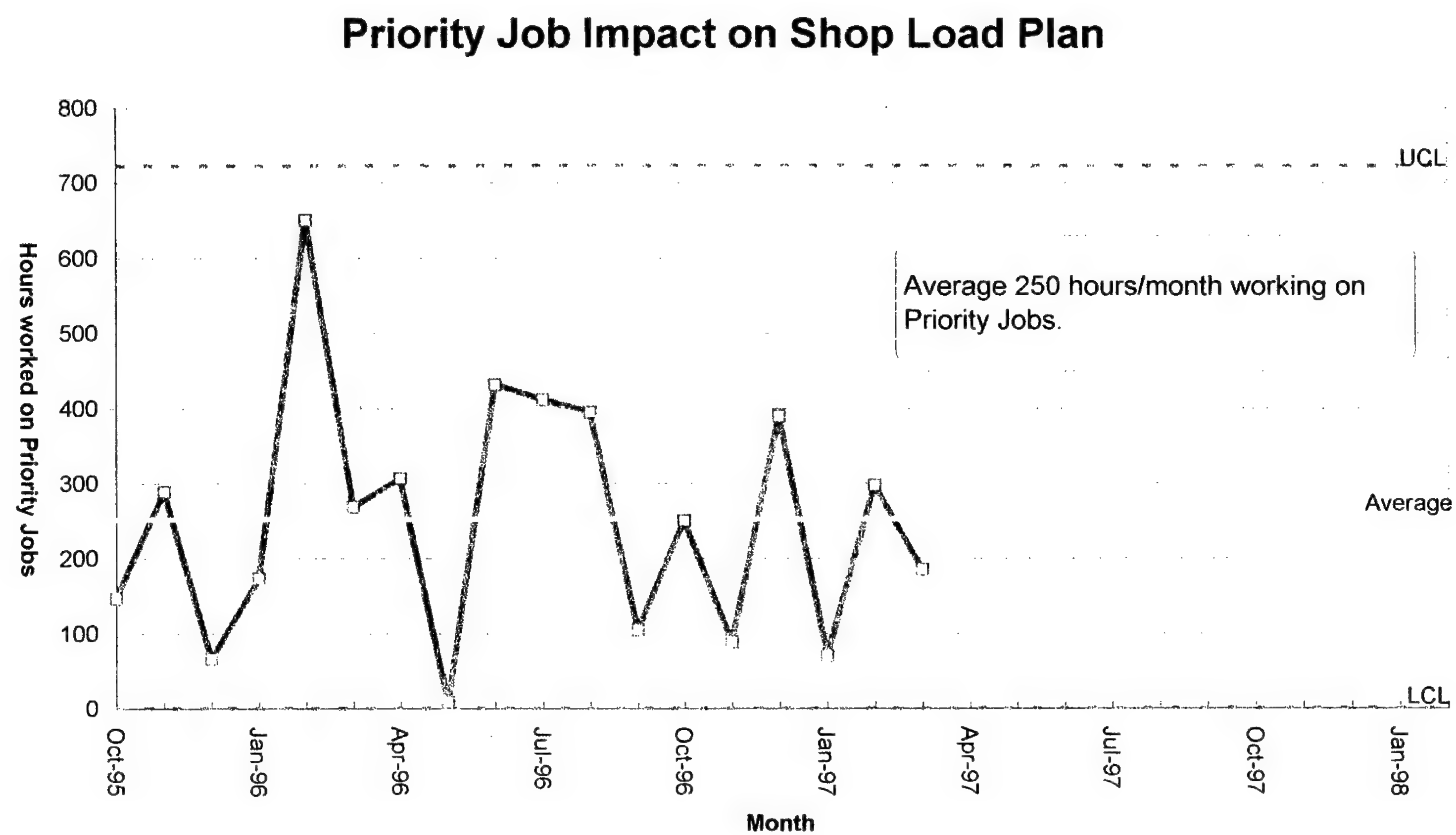


Figure B5.2 - Example of Impact of Priority Jobs on Shop Load Plan

Table B5.3 - Effect of Leave Planning on Shop Load Plan

Metric	Effect of Leave Planning on Shop Load Plan
Definition of what is being measured	Planned leave hours v. actual leave hour.
Justification for the measurement. Key result areas supported	Resource Utilization
Description. Definition of all terms involved in the measure and units	Work hours - includes annual, emergency and sick leave. Planned - estimated leave hours Actual - actual leave hours used
Sources of data	Time cards, labor distribution cards
Data presentation method. Chart type, software used	Run Chart, Control Chart Excel
Update cycle	Monthly update
Responsibility for data collection, plotting analysis	Production Controller
Distribution of updated charts	PWO/APWO/Shops Engineer/ Facilities Management Engineering Director
Highest level of review	Shops Engineer
Who is responsible for taking necessary control action	Shops Engineer, Maintenance Division Director
Comments and summary:	Ratio doesn't indicate actual +/- hours. Ratio greater than 1 indicates less leave taken than planned, less than 1 indicates more leave taken than planned. More leave taken than planned means less hours available for the shop load plan.

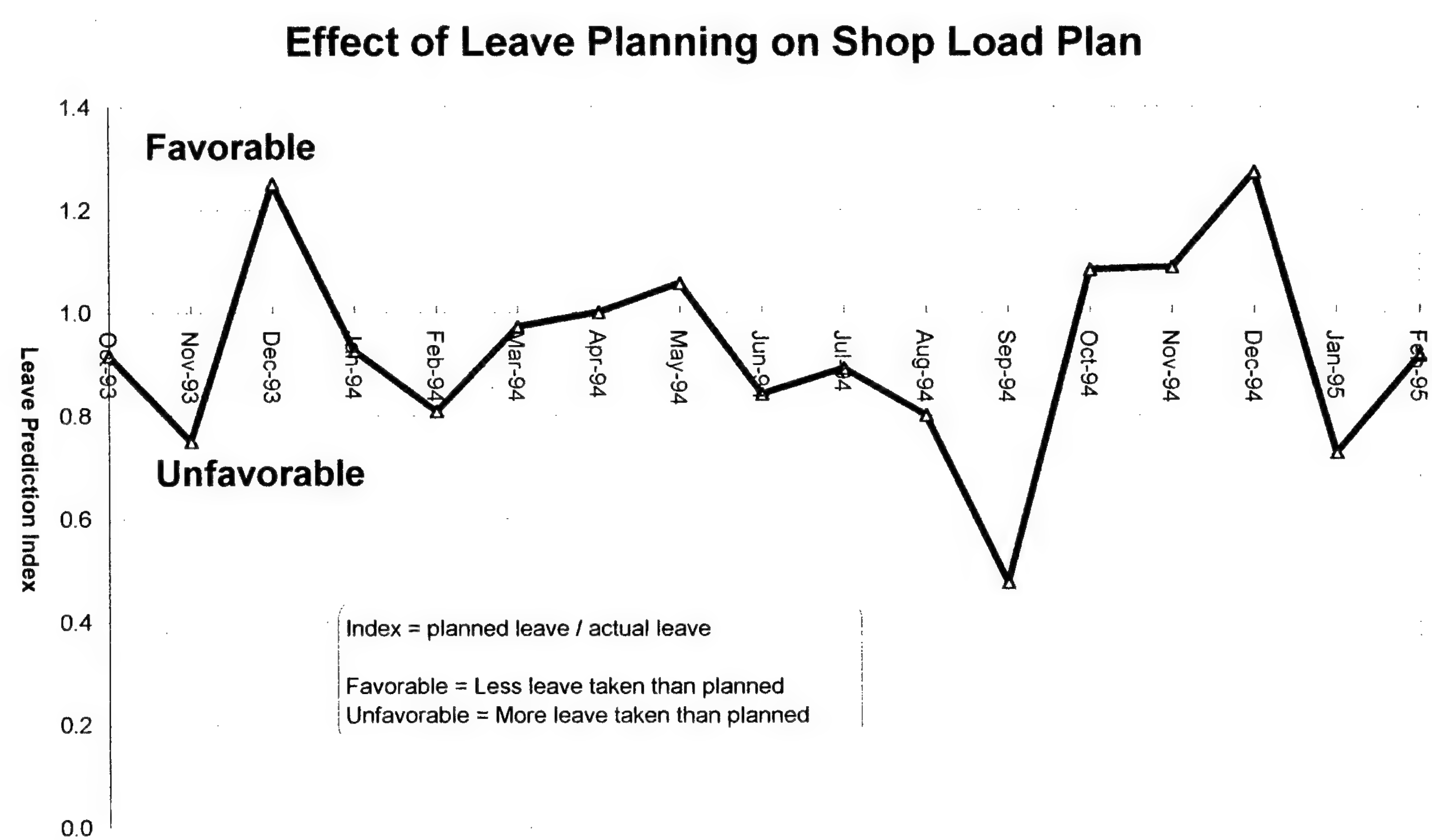


Figure B5.3 - Example of Leave Predictability

Table B5.4 - In-House Efficiency

Metric	In-House Efficiency
Definition of what is being measured	Efficiency of in-house shop forces on maintenance projects
Justification for the measurement. Key result areas supported	Resource Utilization
Description. Definition of all terms involved in the measure and units	Efficiency: $\left(1-\frac{\text{actual hours - est. hours}}{\text{est. hours}}\right)*100$
Sources of data	Labor cards and shop load plan
Data presentation method. Chart type, software used	Control Chart Excel
Update cycle	Monthly
Responsibility for data collection, plotting analysis	Maintenance Division Director, Production Controller
Distribution of updated charts	PWO/APWO/Shops Engineer/ Facilities Management Engineering Director
Highest level of review	PWO
Who is responsible for taking necessary control action	Shops Engineer, Maintenance Division Director
Comments and summary:	Weakness arises when original estimate is inaccurate. Review amendment process. Too many times the estimator just increases the authorized hours to reflect the actual hours spent on the job.

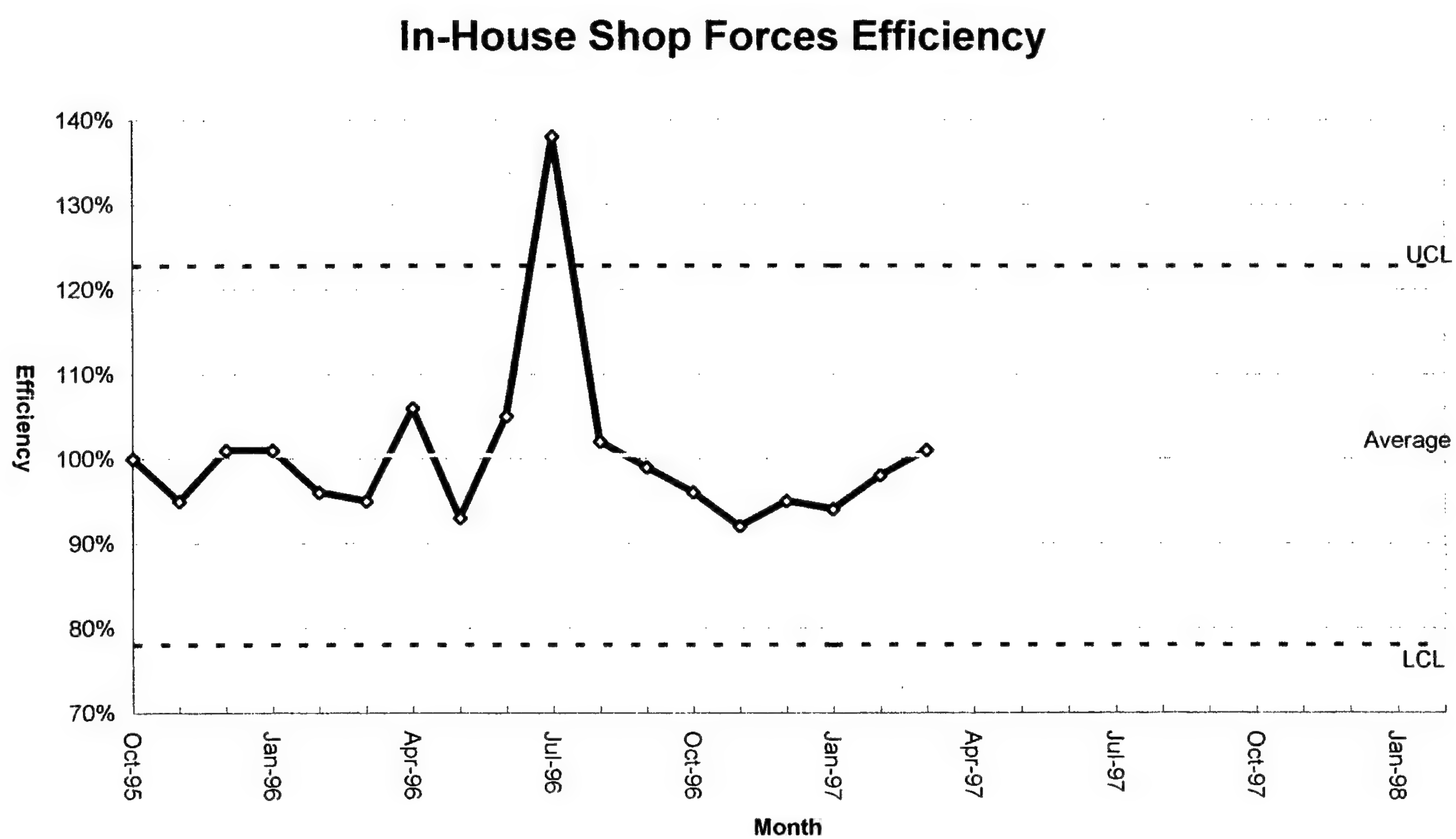


Figure B5.4 - Example of In-House Shop Forces Efficency

Table B5.5 - Work Delays

Metric	Work Delays
Definition of what is being measured	Identifying causes of delay for shop forces
Justification for the measurement. Key result areas supported	Cost Management and Resource Utilization
Description. Definition of all terms involved in the measure and units	Work hours - time spent on the job
Sources of data	Shop Work forces, foremen complete survey
Data presentation method. Chart type, software used	Histogram Excel
Update cycle	Quarterly
Responsibility for data collection, plotting analysis	Maintenance Division Director, Production Controller, Facilities Maintenance Supervisor (General Foreman)
Distribution of updated charts	PWO / APWO / Shops Engineer / Facilities Management Engineering Director / Engineering Division Director
Highest level of review	PWO
Who is responsible for taking necessary control action	Shops Engineer, Maintenance Division Director
Comments and summary:	Foremen complete survey over a pre-determined time period (1 day/week) or (1 week/month)

FOREMAN DELAY SURVEY

Date:__________ Craft:____________________ Foreman's Name:____________________

Number in shop:________________________________

Delay Causes	Number of Hours Delayed	Number of Workers	Work hours Delayed
1. Waiting for materials (warehouse)			
2. Waiting for materials (off site)			
3. Waiting for tools			
4. Waiting for equipment			
5. Re-work (design changes or errors)			
6. Re-work (prefabrication errors)			
7. Re-work (field errors)			
8. Moving to other areas			
9. Waiting for information			
10. Waiting for work or flame permits			
11. Waiting on contractor			
12. Interference with other contractors / crews			
13. Other (Specify)			
14. Comments			

Figure B5.5 - Foreman Delay Data Collection Sheet

Table B5.6 - Service Call Completion

Metric	Service Call Completion
Definition of what is being measured	Average completion time of service calls
Justification for the measurement. Key result areas supported	Resource utilization
Description. Definition of all terms involved in the measure and units	Completion Time - average time for service call completion. Units - days
Sources of data	PWD Database (ECMS??)
Data presentation method. Chart type, software used	Run Chart, Control Chart (later) Excel
Update cycle	Monthly Update
Responsibility for data collection, plotting analysis	Production Controller
Distribution of updated charts	Shops Engineer, Maintenance Division Director, E&S Shops
Highest level of review	Shops Engineer
Who is responsible for taking necessary control action	Shops Engineer, Maintenance Division Director
Comments and summary:	Tracking of service call completion time provides information to the customer as to when they can reasonably expect their call to be completed

Hypothetical Data

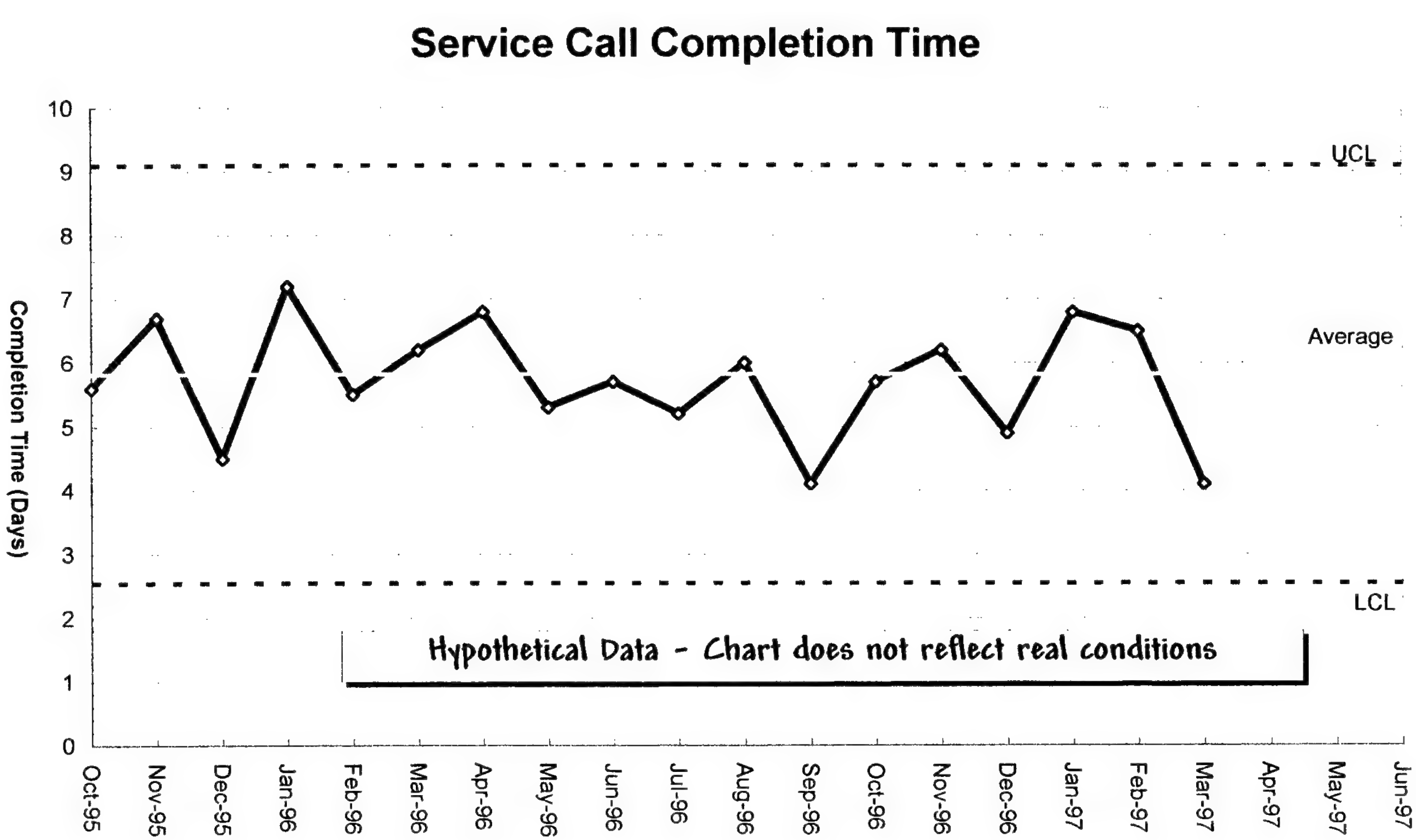


Figure B5.6 - Example of Service Call Completion Time

Table B5.7 - Service Call Backlog

Metric	Service Call Backlog
Definition of what is being measured	Measure of Backlog the PWD Service calls.
Justification for the measurement. Key result areas supported	Resource utilization
Description. Definition of all terms involved in the measure and units	Backlog indicates outstanding service calls that are scheduled for completion by the Emergency Services Section of PWD.
Sources of data	PWD Database (ESMS?)
Data presentation method. Chart type, software used	Histogram (grouped into trades)
Update cycle	Weekly
Responsibility for data collection, plotting analysis	Production Controller
Distribution of updated charts	Shops Engineer, shops
Highest level of review	Shops Engineer
Who is responsible for taking necessary control action	Shops Engineer, Maintenance Division Director
Comments and summary:	Breakdown by trades will alert foreman to possibility of process going out of control Service calls out of scope requiring planning and estimating are removed from E/S and transferred to maintenance backlog. hypothetical data - actual not available

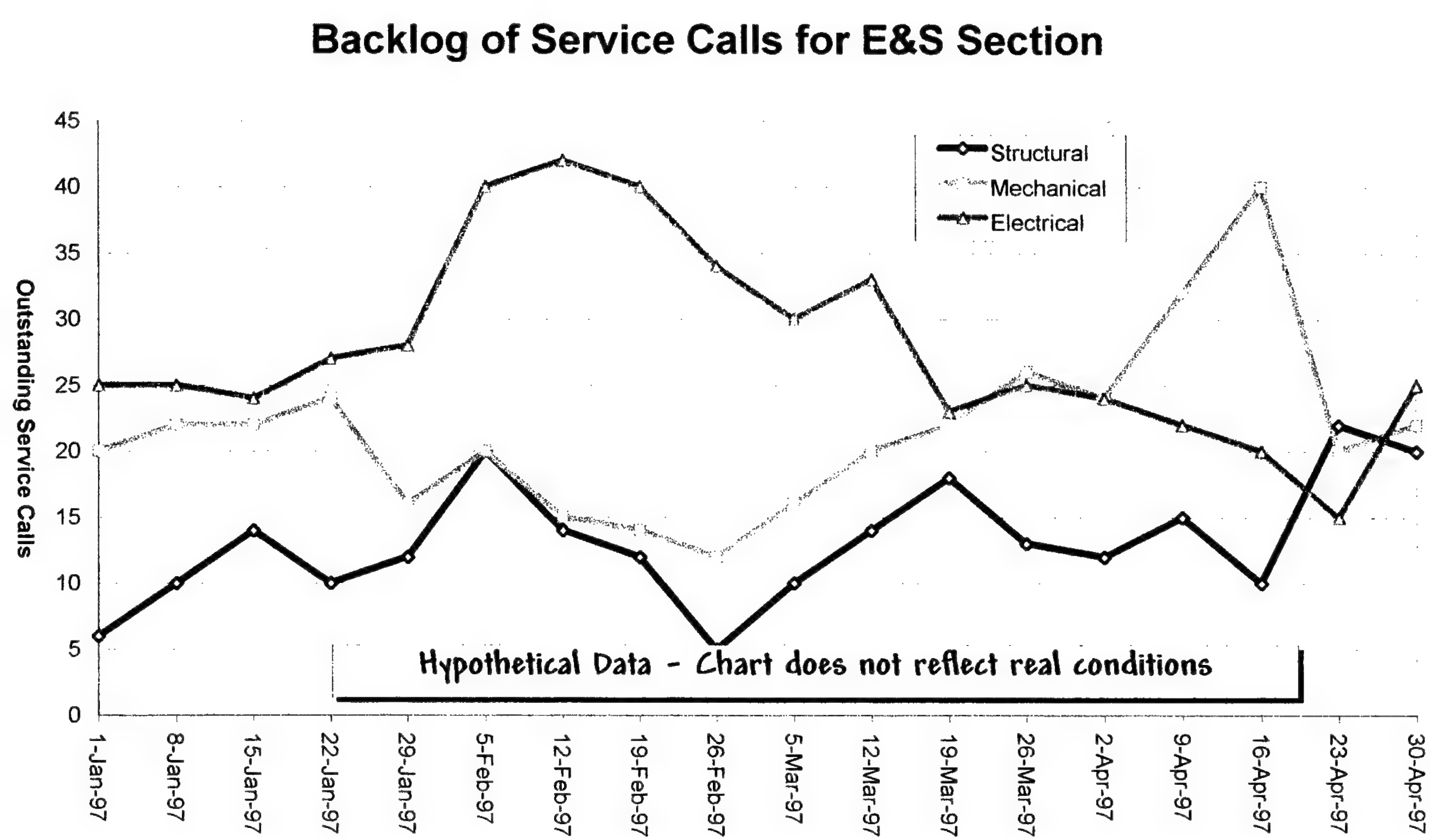


Figure B5.7 - Example of Backlog for Routine Service Calls

Table B5.8 - Jobs using MS Project

Metric	Jobs using MS Project
Definition of what is being measured	Measurement of PWD Jobs using MS Project to track and schedule
Justification for the measurement. Key result areas supported	Resource utilization
Description. Definition of all terms involved in the measure and units	Units - Number of jobs using MS Project to track and schedule work during the current month
Sources of data	Shops
Data presentation method. Chart type, software used	Run Chart
Update cycle	Monthly
Responsibility for data collection, plotting analysis	Production Controller
Distribution of updated charts	Shops Engineer, Maintenance Division Director
Highest level of review	Shops Engineer
Who is responsible for taking necessary control action	Shops Engineer, Maintenance Division Director
Comments and summary:	Tracking of actual jobs using MS Project should show trend over time of increased use of scheduling techniques. hypothetical data - actual not available

Hypothetical Data

History of Scheduling Improvement

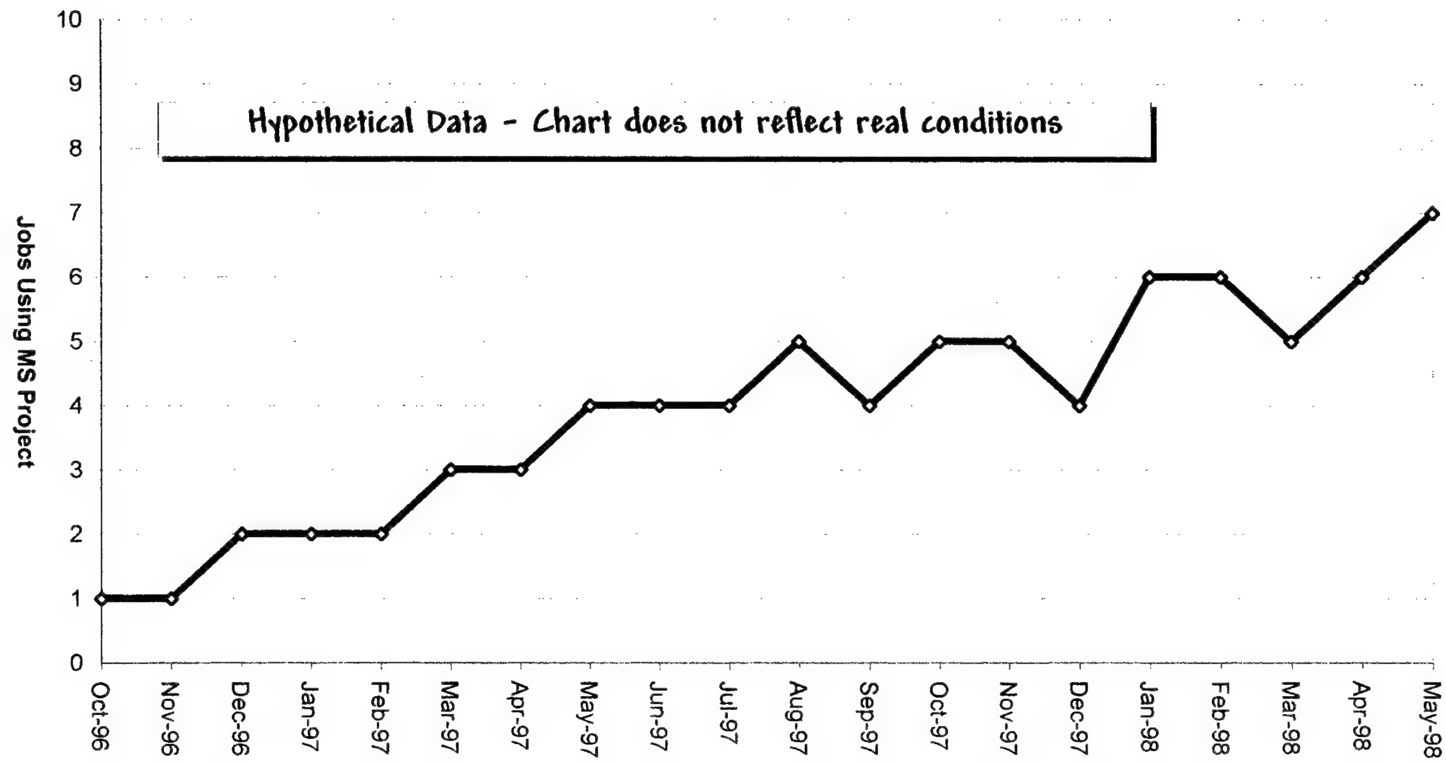


Figure B5.8 - Tracking of Jobs using MS Project for Scheduling

Appendix B6 - Utilities Metrics

Table B6.1 - Electricity Use

Metric	Electricity Use
Definition of what is being measured	Average Daily use of electricity on base
Justification for the measurement. Key result areas supported	Cost management & Resource utilization
Description. Definition of all terms involved in the measure and units	Daily KWH Used - Average of monthly usage to show a better representation due to unequal days of the month.
Sources of data	Base power plant and billings from suppliers
Data presentation method. Chart type, software used	Run Chart, Control Chart Excel
Update cycle	Monthly Update
Responsibility for data collection, plotting analysis	Utilities Division Director
Distribution of updated charts	Shops Engineer, Utilities Division Director, White Falcon
Highest level of review	Utilities Division Director
Who is responsible for taking necessary control action	Utilities Division Director
Comments and summary:	Tracking and reporting to the base users through base wide media (White Falcon, Newsline) on a monthly basis will provide feedback as to how the base is doing in conserving electricity. Informative, brief articles accompanying the graphs as to how the residents can help conserve energy will provide additional impact.

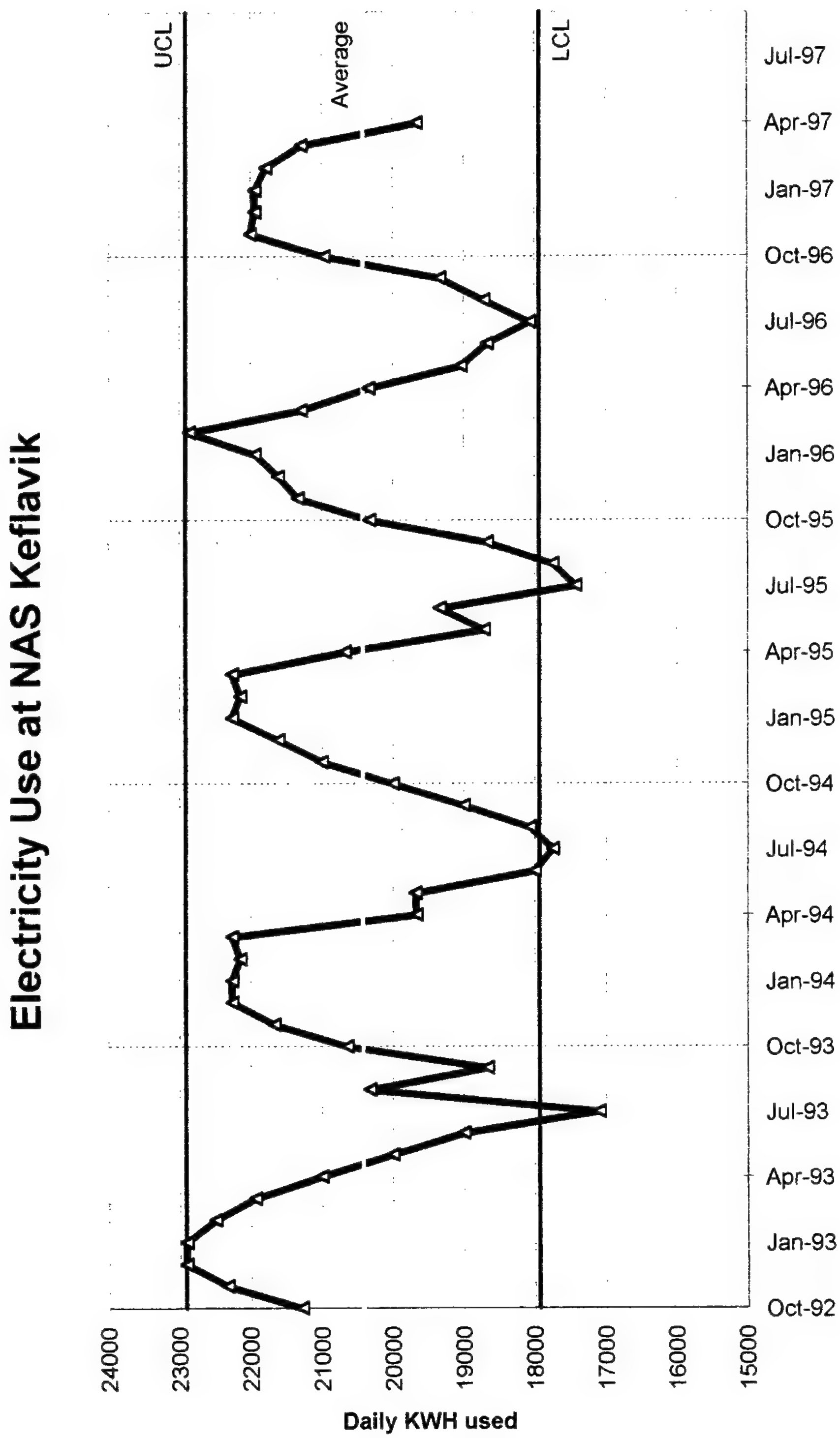


Figure B6.1 - Example of Electricity Use

Table B6.2 - Water Use

Metric	Water Use
Definition of what is being measured	Amount of water used by base
Justification for the measurement. Key result areas supported	Resource utilization
Description. Definition of all terms involved in the measure and units	Units - millions of gallons
Sources of data	Base Water Plant - readings taken on a daily basis
Data presentation method. Chart type, software used	Run Chart, Control Chart (later) Excel
Update cycle	Monthly Update
Responsibility for data collection, plotting analysis	Utilities Division Director, Water Plant Supervisor
Distribution of updated charts	Shops Engineer, Utilities Division Director, White Falcon PWO, APWO
Highest level of review	Utilities Division Director
Who is responsible for taking necessary control action	Utilities Division Director
Comments and summary:	Under the current water contract, the base receives the water free of charge. This will change under the new contract. Tracking and reporting to the base users through base wide media (White Falcon, Newsline) on a monthly basis will provide feedback as to how the base is doing in conserving water.

Water Usage at NAS Keflavik

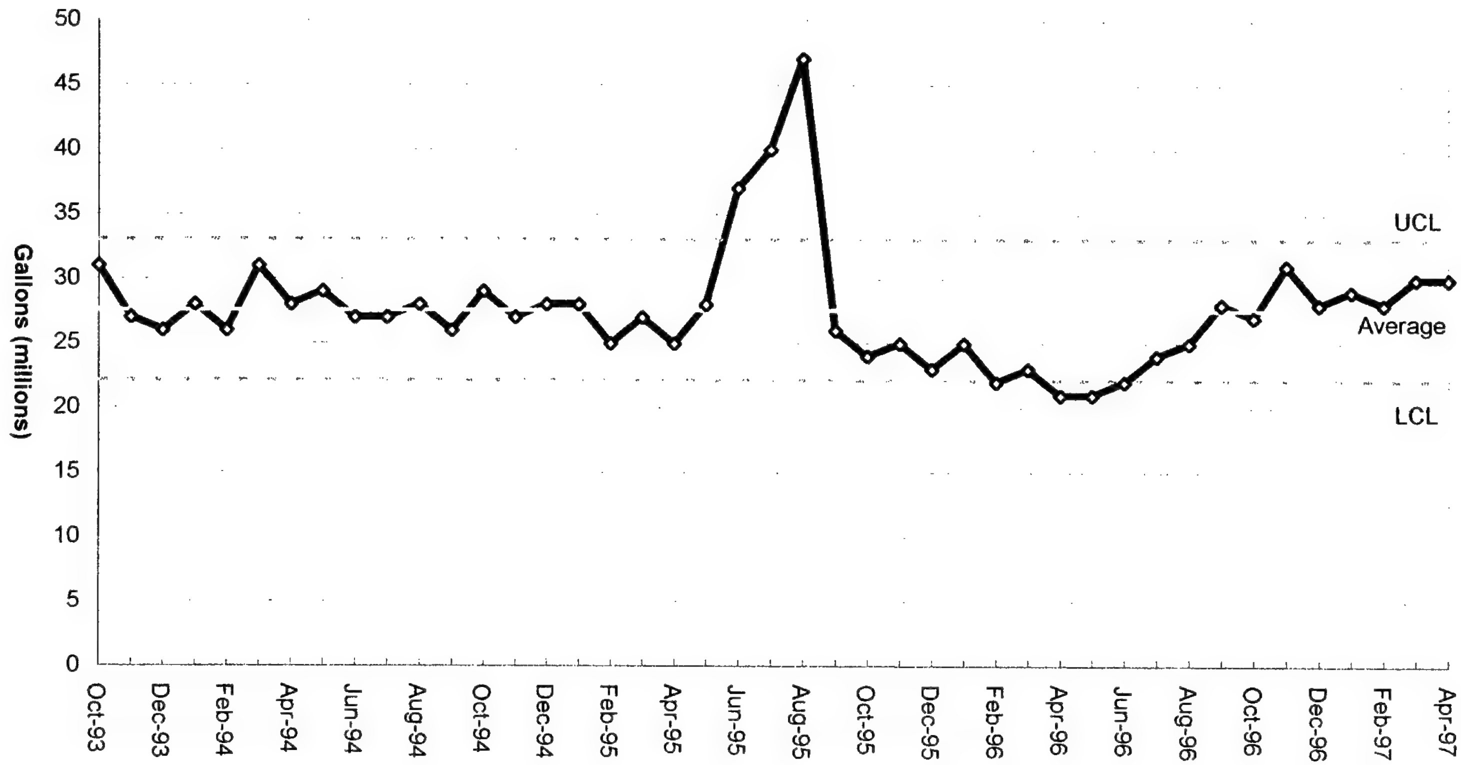


Figure B6.2 - Example of Water Use

Table B6.3 - Geothermal Heating

Metric	Geothermal Heating
Definition of what is being measured	Heating water flow into the base
Justification for the measurement. Key result areas supported	Resource utilization
Description. Definition of all terms involved in the measure and units	Liters/minute - total liters per minute flowing into the base Units - Liters/minute
Sources of data	Bills from suppliers (Sudenes Regional Heating Authority)
Data presentation method. Chart type, software used	Run Chart Excel
Update cycle	Monthly Update
Responsibility for data collection, plotting analysis	Utilities Division Director, Management and Budget Technician
Distribution of updated charts	PWO, APWO, Shops Engineer, Utilities Division Director
Highest level of review	PWO
Who is responsible for taking necessary control action	Utilities Division Director
Comments and summary:	This measurement is mainly for reviewing past information. Flows are controlled by PW and the geothermal contract.

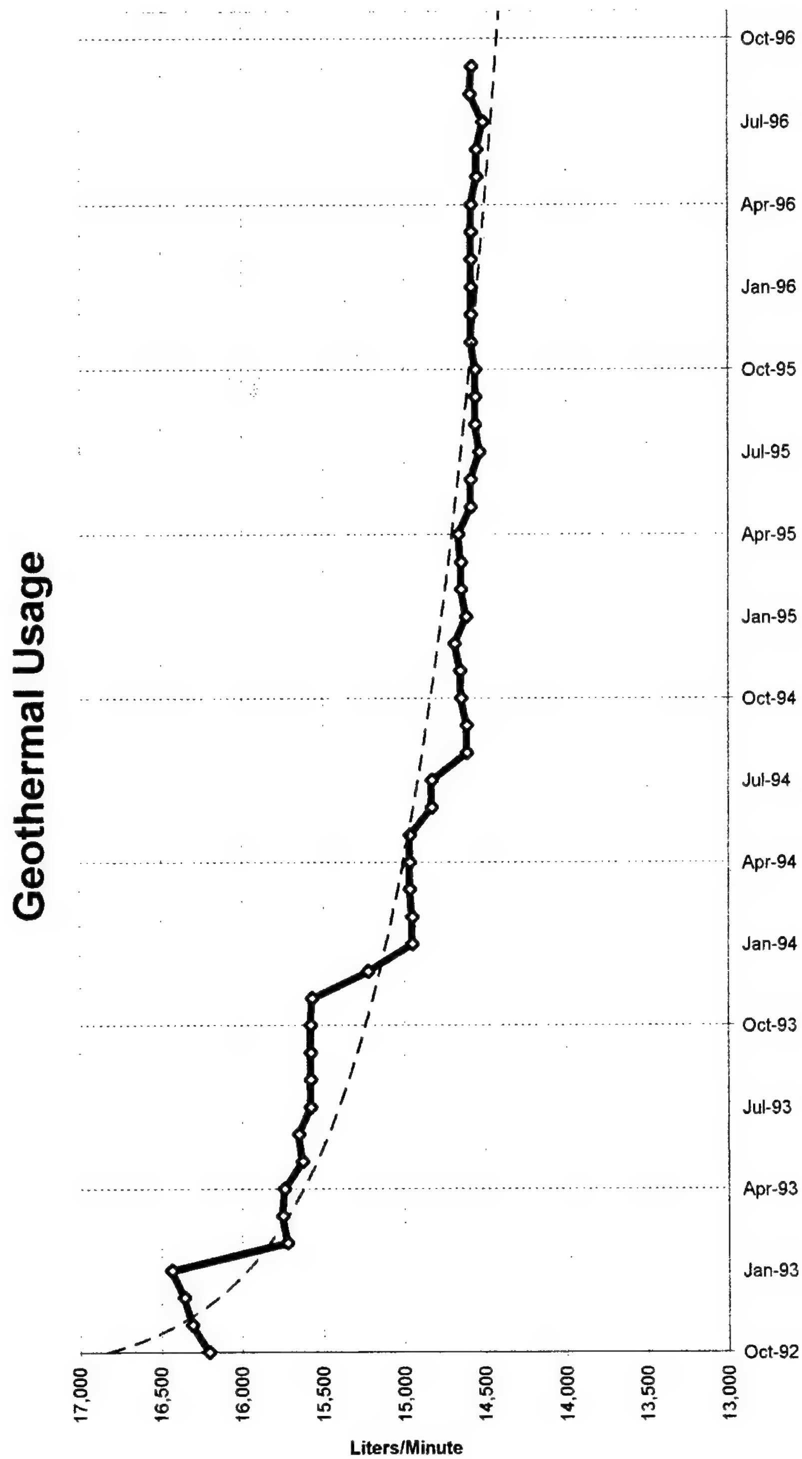


Figure B6.3 - Example of Geothermal Usage at NAS Keflavik

Appendix B7 - Transportation Metrics

Table B7.1 – Vehicle Down-time

Metric	Vehicle Availability
Definition of what is being measured	Average Monthly Percentage of Class 'C' vehicle availability
Justification for the measurement. Key result areas supported	Customers, Resource Utilization
Description. Definition of all terms involved in the measure and units	Availability - vehicle is in operating condition
Sources of data	PC Transport Database
Data presentation method. Chart type, software used	Run Chart, control chart (later) Excel
Update cycle	Monthly Update
Responsibility for data collection, plotting analysis	Transportation Officer
Distribution of updated charts	PWO, APWO, Transportation Officer
Highest level of review	PWO
Who is responsible for taking necessary control action	Transportation Officer
Comments and summary:	Develop criteria for availability that is meaningful for both PW and customers hypothetical data - actual not available

Hypothetical Data

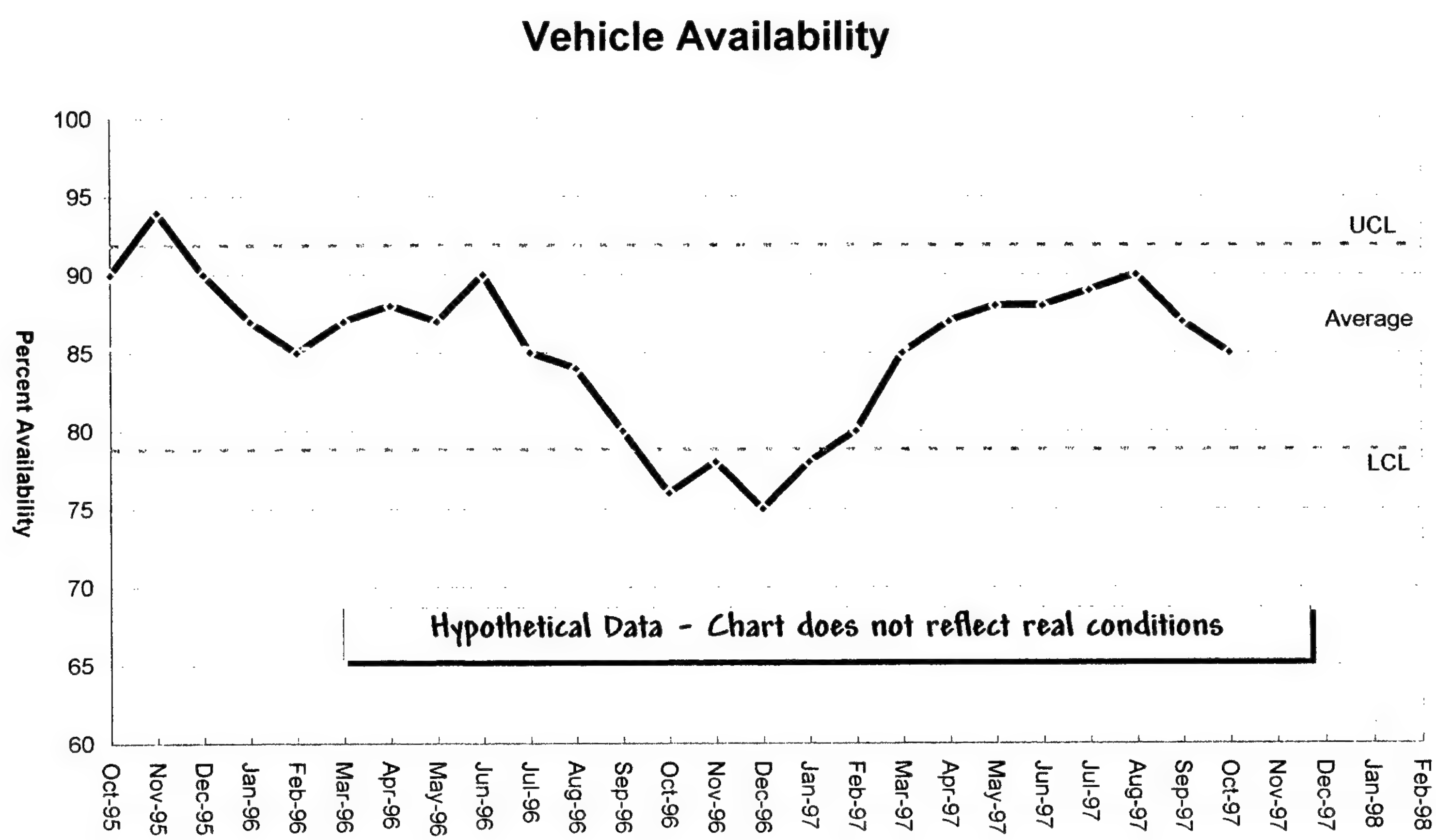


Figure B7.1 - Example of Class 'C' Vehicle Availability

Table B7.2 - Vehicle Turn-Around Time

Metric	Vehicle Turn-Around Time
Definition of what is being measured	Average time for completion of repairs to vehicles
Justification for the measurement. Key result areas supported	Customers, Resource Utilization
Description. Definition of all terms involved in the measure and units	Repair Time - Number of days from time vehicle is delivered to PW until time it is returned to the customer.
Sources of data	PC Transport Database
Data presentation method. Chart type, software used	Run Chart, control chart (later) Excel
Update cycle	Monthly Update
Responsibility for data collection, plotting analysis	Transportation Officer
Distribution of updated charts	PWO, APWO, Transportation Officer
Highest level of review	PWO
Who is responsible for taking necessary control action	Transportation Officer
Comments and summary:	hypothetical data - actual not available

Hypothetical Data

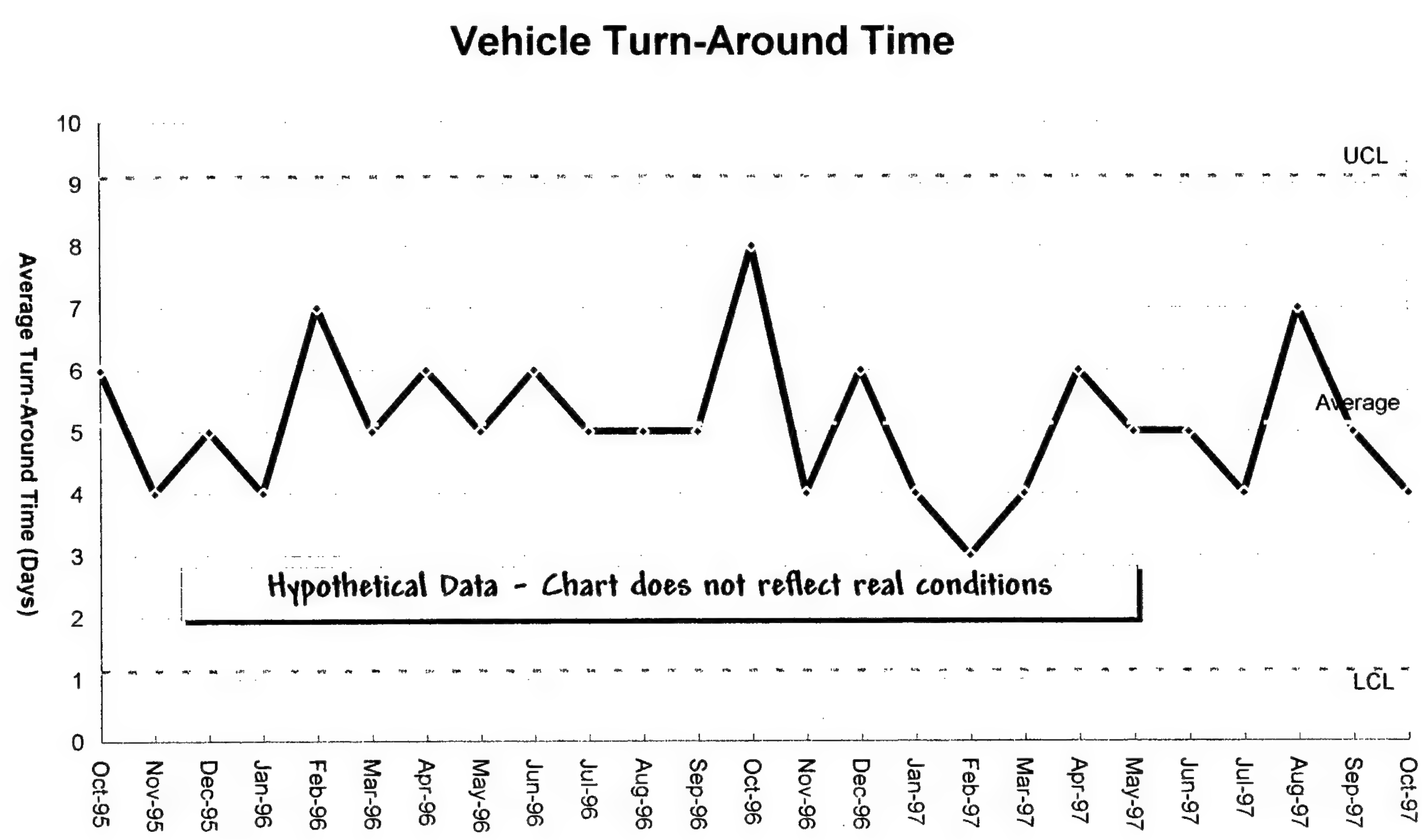


Figure B7.2 - Example of Vehicle Turn-Around Time

Appendix B8 - Contracts Metrics

Table B8.1 – Invoice Turn-Around Time

Metric	Invoice Turn-Around Time
Definition of what is being measured	Average time for Contracts Division to process contractor's invoice
Justification for the measurement. Key result areas supported	Cost management
Description. Definition of all terms involved in the measure and units	Invoice Time - Number of days from time Contracts receives invoice until time processing is complete
Sources of data	Procurement records
Data presentation method. Chart type, software used	Run Chart, control chart (later) Excel
Update cycle	Monthly Update
Responsibility for data collection, plotting analysis	Procurement Clerks, Contract Specialists
Distribution of updated charts	PWO, APWO, Contracts Division Director
Highest level of review	PWO
Who is responsible for taking necessary control action	Contracts Division Director
Comments and summary:	hypothetical data - actual not available

Hypothetical Data

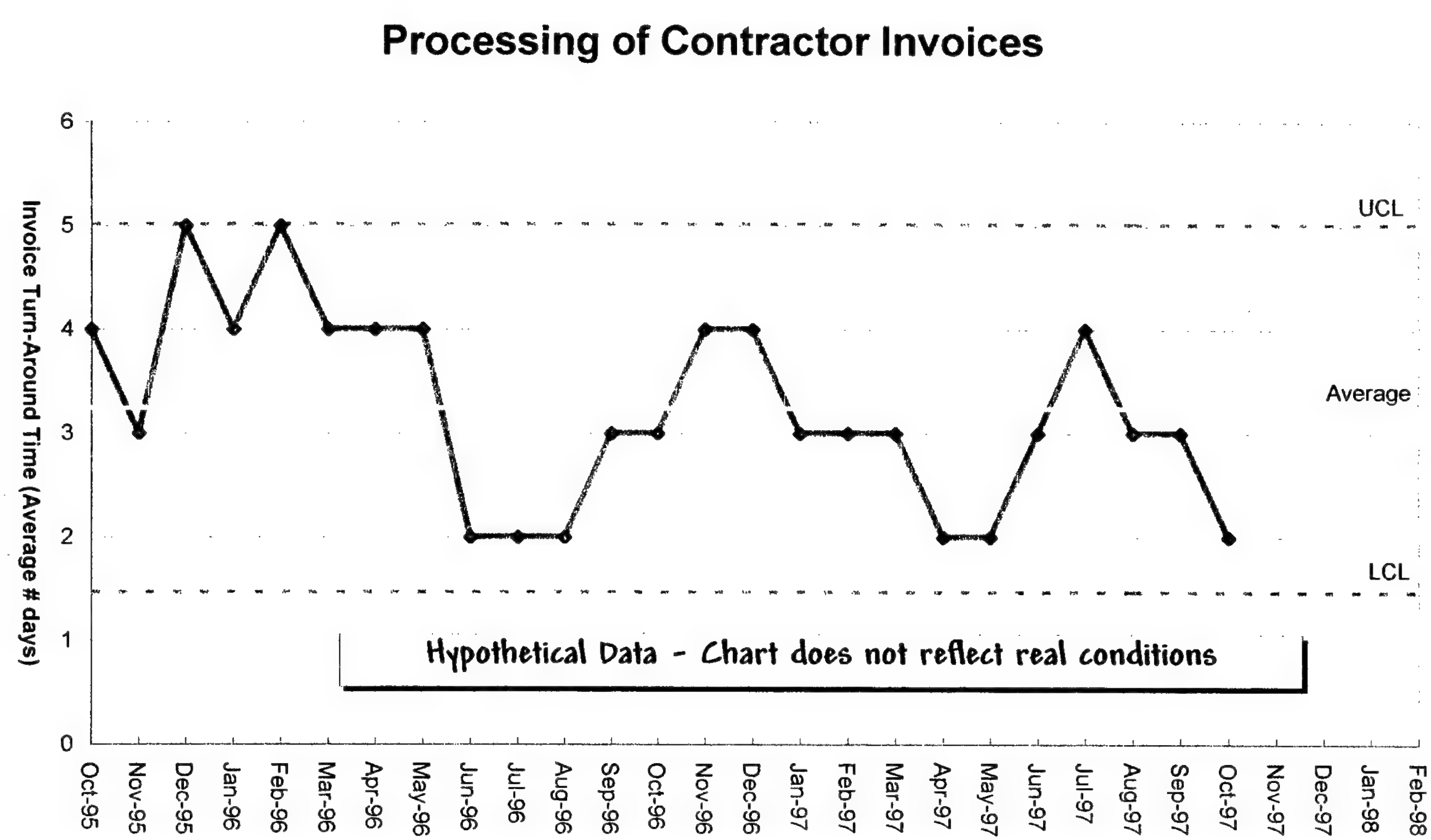


Figure B8.1 - Control Chart Tracking Processing Times for Contractor's Invoices

Table B8.2 – Contractor Performance Evaluation

Metric	Contractor Performance Evaluation
Definition of what is being measured	Annual performance of Service Contractors
Justification for the measurement. Key result areas supported	Customer
Description. Definition of all terms involved in the measure and units	
Sources of data	Contract files
Data presentation method. Chart type, software used	Histogram, Excel
Update cycle	Annual Update
Responsibility for data collection, plotting analysis	Contract Specialist, FSCM
Distribution of updated charts	PWO, APWO, Contracts Division Director
Highest level of review	PWO
Who is responsible for taking necessary control action	Contracts Division Director
Comments and summary:	

Table B8.3 – Customer Satisfaction

Metric	Customer Satisfaction
Definition of what is being measured	Satisfaction of Base Customers on the services they receive from the contractors
Justification for the measurement. Key result areas supported	Customers
Description. Definition of all terms involved in the measure and units	
Sources of data	Inspection Surveys
Data presentation method. Chart type, software used	Histogram, Paraedo Chart Excel
Update cycle	Monthly Update
Responsibility for data collection, plotting analysis	FSCM
Distribution of updated charts	PWO, APWO, Contracts Division Director
Highest level of review	PWO
Who is responsible for taking necessary control action	FSCM
Comments and summary:	Develop a short series of questions to ask random customers about the service they receive from contracted work. Compile the information into a meaningful presentation.

Table B8.4 - Procurement Action Lead Time

Metric	Procurement Action Lead Time
Definition of what is being measured	Comparison of Actual Procurement Actions with scheduled actions
Justification for the measurement. Key result areas supported	Customers, Resource Utilization
Description. Definition of all terms involved in the measure and units	Scheduled Time - Estimated Time of action Actual Time - Actual completion date
Sources of data	Contract Database
Data presentation method. Chart type, software used	Excel
Update cycle	Monthly Update
Responsibility for data collection, plotting analysis	Contracting Officer, Contract Specialist, Procurement Clerk
Distribution of updated charts	PWO, APWO, Contracts Division Director
Highest level of review	OIC
Who is responsible for taking necessary control action	Contracting Officer
Comments and summary:	

Appendix B9 - Environmental Metrics

Table B9.1 – Hazardous Waste Pick-Up

Metric	Hazardous Waste Pick-Up
Definition of what is being measured	Response time to pick up hazardous waste
Justification for the measurement. Key result areas supported	Safety, Customer
Description. Definition of all terms involved in the measure and units	Response Time - Length of time from receiving initial request to time waste is picked up
Sources of data	Environmental Records
Data presentation method. Chart type, software used	Run Chart, control chart (later) Excel
Update cycle	Monthly Update
Responsibility for data collection, plotting analysis	60E11 Hazardous Waste Services
Distribution of updated charts	PWO, APWO, Environmental Officer
Highest level of review	PWO
Who is responsible for taking necessary control action	Environmental Officer
Comments and summary:	hypothetical data - actual not available

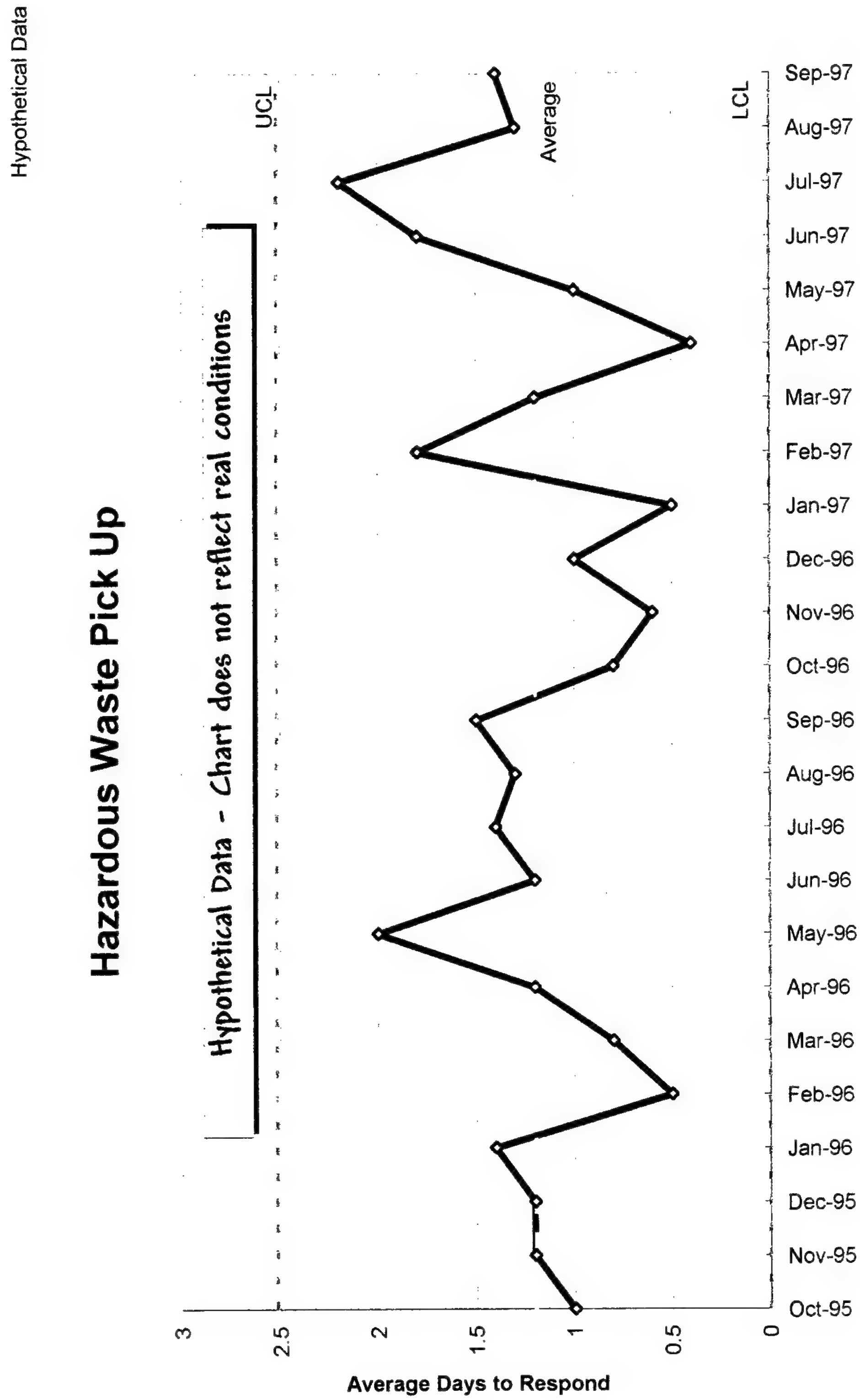


Figure B9.1 - Example of Hazardous Waste Pick Up Response Time

Table B9.2 – Spill Response Time

Metric	Spill Response Time
Definition of what is being measured	Response time for hazardous waste spills
Justification for the measurement. Key result areas supported	Safety, Customers
Description. Definition of all terms involved in the measure and units	Response Time - Length of time from receiving initial notification to time on site.
Sources of data	Environmental Records
Data presentation method. Chart type, software used	Run Chart, control chart (later) Excel
Update cycle	Monthly Update
Responsibility for data collection, plotting analysis	60E11 Environmental Support Services
Distribution of updated charts	PWO, APWO, Environmental Officer
Highest level of review	PWO
Who is responsible for taking necessary control action	Environmental Officer
Comments and summary:	hypothetical data - actual not available

Hypothetical Data

Spill Response Time

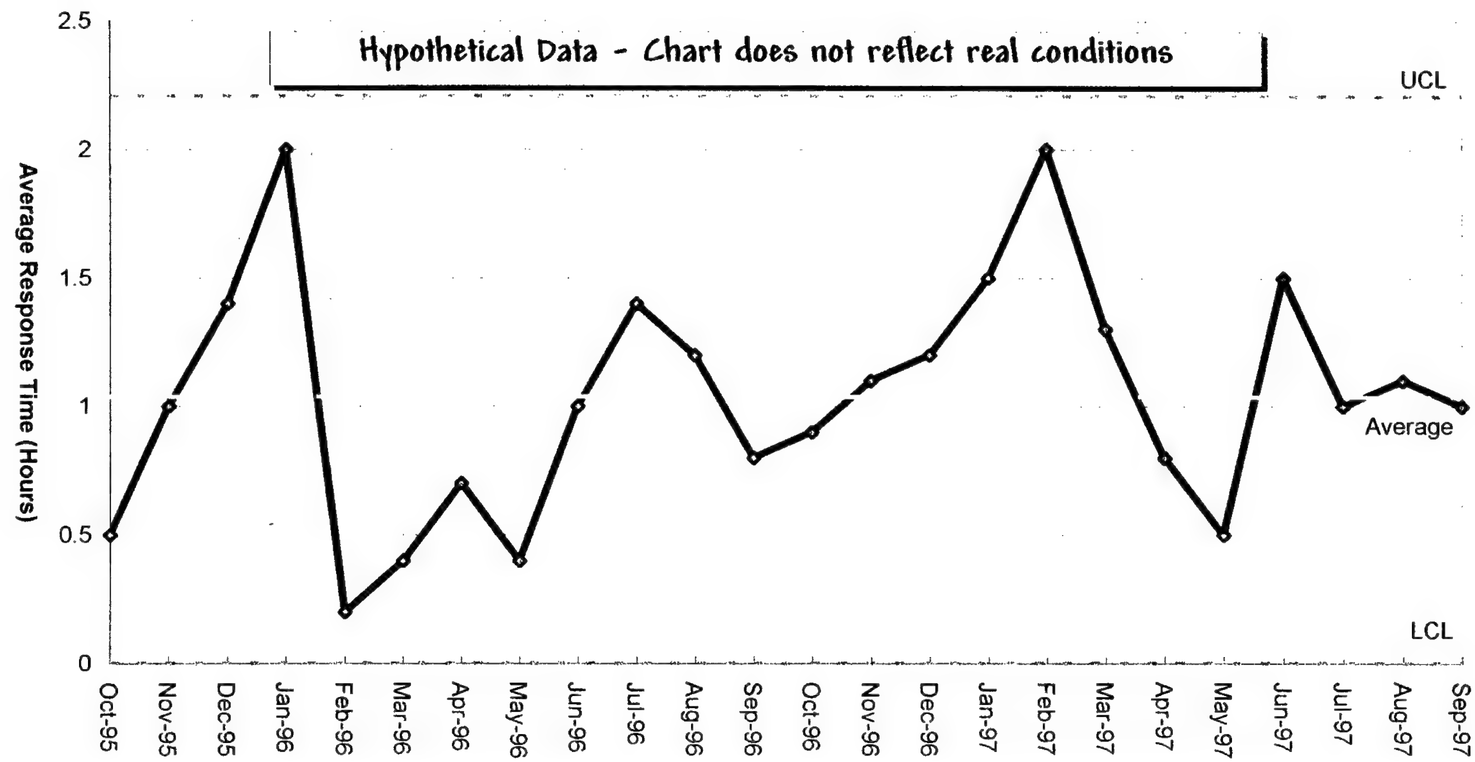


Figure B9.2 - Example of Spill Response Time

Table B9.3 – Construction Review

Metric	Construction Review
Definition of what is being measured	Number of construction reviews performed by Environmental Division and average time for review
Justification for the measurement. Key result areas supported	Safety, Resource Utilization
Description. Definition of all terms involved in the measure and units	Review Time - Length of time from receiving initial request to time construction review is completed
Sources of data	Internal record tracking
Data presentation method. Chart type, software used	Run Chart, control chart (later) Excel
Update cycle	Monthly Update
Responsibility for data collection, plotting analysis	60E2 and 60E3, Environmental Engineers
Distribution of updated charts	PWO, APWO, Environmental Officer
Highest level of review	PWO
Who is responsible for taking necessary control action	Environmental Officer
Comments and summary:	hypothetical data - actual not available

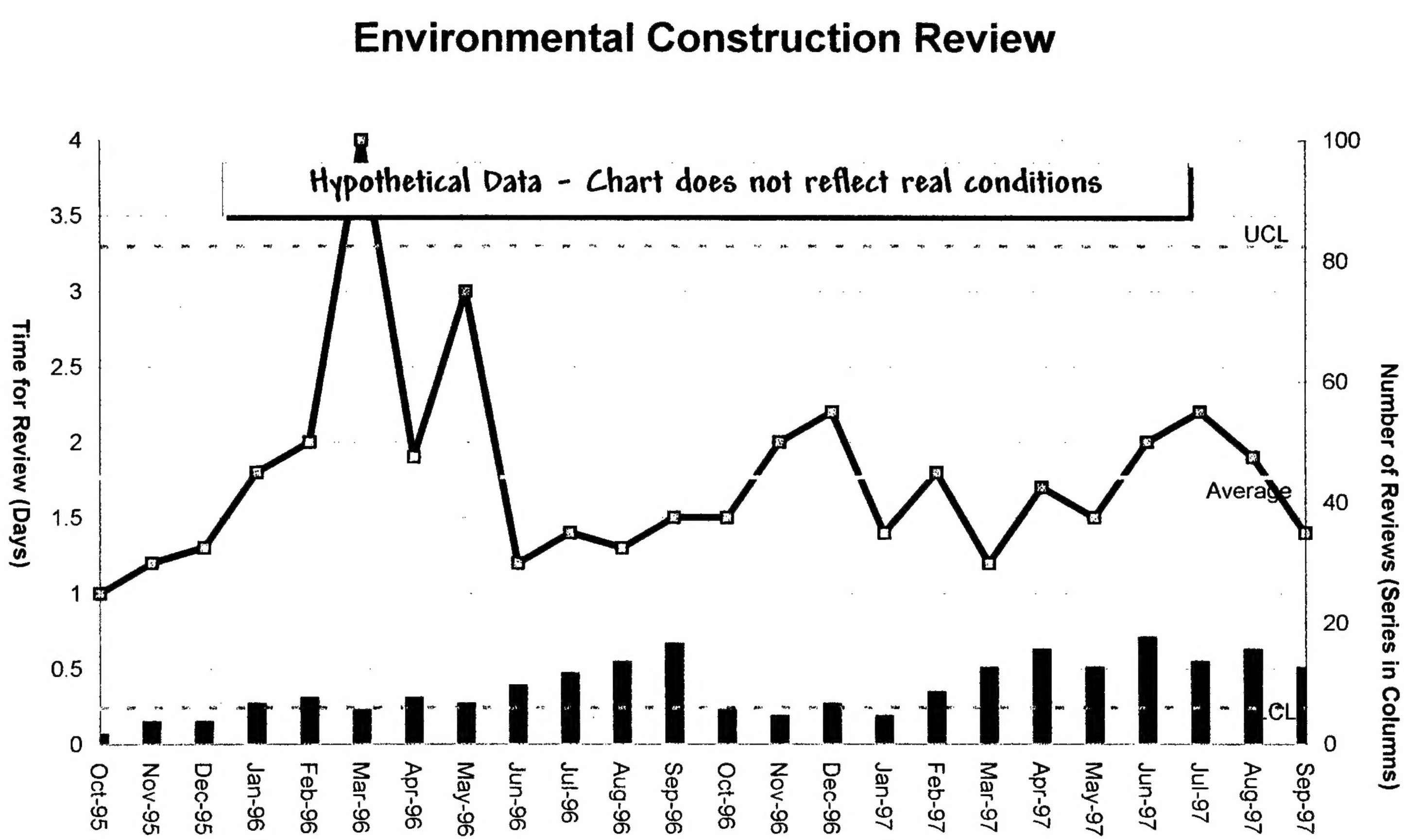


Figure B9.3 - Example of Construction Review Measurements

Table B9.4 – Water Quality

Metric	Water Quality
Definition of what is being measured	Consistency of Water Quality at NAS Keflavik
Justification for the measurement. Key result areas supported	Safety
Description. Definition of all terms involved in the measure and units	
Sources of data	Environmental Records
Data presentation method. Chart type, software used	Histogram Excel (Run/Control chart if data is quantifiable)
Update cycle	Monthly Update
Responsibility for data collection, plotting analysis	60E3, Environmental Engineer (Water Resources Program Director)
Distribution of updated charts	PWO, APWO, Environmental Officer
Highest level of review	PWO
Who is responsible for taking necessary control action	Environmental Officer
Comments and summary:	No chart developed yet -- determine the best type based on data collection

Appendix C - List of Acronyms

Acronym	*Description*
AIS	Annual Inspection Summary
APWO	Assistant Public Works Officer
CINCLANTFLT	Commander-In-Chief, Atlantic Fleet
DON	Department of Navy
FMED	Facilities Management Engineering Division
FSC	Facilities Support Contracts
FSCM	Facilities Support Contract Manager
HRO	Human Resources Office
LANTDIV	Atlantic Division of NAVFAC
NAS	Naval Air Station
NAVFAC	Naval Facilities Engineering Command
OPTAR	Operation Target (Budget Goal)
P&E	Planning & Estimating
PWD	Public Works Department
PWO	Public Works Officer
SIPOC	Supply-Input-Process-Output-Customer
SJO	Standing Job Order
TQL	Total Quality Leadership
TQM	Total Quality Management

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